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The scientific publications of the National Museum include two series, known, respectively, as *Proceedings* and *Bulletin*.

The *Proceedings* series, begun in 1878, is intended primarily as a medium for the publication of original papers, based on the collections of the National Museum, that set forth newly acquired facts in biology, anthropology, and geology, with descriptions of new forms and revisions of limited groups. Copies of each paper, in pamphlet form, are distributed as published to libraries and scientific organizations and to specialists and others interested in the different subjects. The dates at which these separate papers are published are recorded in the table of contents of each of the volumes.

The present volume is the eighty-sixth of this series.

The series of *Bulletins*, the first of which was issued in 1875, contains separate publications comprising monographs of large zoological groups and other general systematic treatises (occasionally in several volumes), faunal works, reports of expeditions, catalogs of type specimens, special collections, and other material of similar nature. The majority of the volumes are octavo in size, but a quarto size has been adopted in a few instances in which large plates were regarded as indispensable. In the *Bulletin* series appear volumes under the heading *Contributions from the United States National Herbarium*, in octavo form, published by the National Museum since 1902, which contain papers relating to the botanical collections of the Museum.

ALEXANDER WETMORE,
Assistant Secretary, Smithsonian Institution.

WASHINGTON, D. C., *June 1, 1940.*

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REVISION OF THE NORTH AMERICAN BEETLES OF THE STAPHYLINID SUBFAMILY TACHYPORINAE—PART 2: GENUS COPROPORUS KRAATZ[1]

By RICHARD E. BLACKWELDER

ABOUT the year 1858 both Kraatz and Motschoulsky, working independently, described and named a genus of Tachyporinae corresponding approximately to Erichson's Family I of *Tachinus*. To this genus Kraatz gave the name of *Coproporus* and Motschoulsky that of *Erchomus*. The identity of the two genera was soon recognized, but uncertainty as to the dates of publication, and therefore to the priority, resulted in opposing views by subsequent writers as to the proper name for the genus. LeConte, Fauvel, Sharp (1876), Eichelbaum, Bernhauer and Schubert, and Cameron have used *Coproporus*, whereas Horn, Sharp (1883), Fowler, Fall, and Leng have used *Erchomus*.

There have undoubtedly been previous investigations into this problem, but I believe no one has heretofore published the facts upon which the decision is based. The information outlined below was kindly supplied to me by A. Mequignon, member of the International Commission on Entomological Nomenclature.

Coproporus Kraatz was published in the Naturgeschichte der Insecten Deutschlands, vol. 2, Staphylinii, p. 399, which was issued definitely in the year 1857, though bearing the date 1858 on the title page. *Erchomus* Motschoulsky was published in the Bulletin de la Société Imperiale des Naturalistes de Moscou, vol. 31, no. 3, p. 218, which was issued in 1858, probably in February.

[1] Part 1: Genus *Tachyporus* Gravenhorst was published in Proc. U. S. Nat. Mus., vol. 84, pp. 39–54, Nov. 17, 1936.

In 1877 the American species of this genus were monographed by Horn, who listed eight names and considered four to be valid. Since that time two new species have been described and one other reported from this country. Both the new species are now considered synonyms, and three new species are described.

In the original descriptions no genotypes of these genera are designated, and I have found no later designations. In order to fix the names permanently I hereby designate *Tachinus rutilus* Erichson as genotype of *Coproporus* Kraatz, and *Erchomus sanguinolentus* Motschoulsky as genotype of *Erchomus* Motschoulsky.

The material available includes approximately 775 specimens from North America and a considerable series of species from other parts of the New World. These comprise the United States National Museum collections and my own.

Genus COPROPORUS Kraatz

1857. *Coproporus* KRAATZ, Naturgeschichte der Insecten Deutschlands, vol. 2, p. 399, footnote. (*Genotype: Tachinus rutilus* Erichson, designated here.)

1858. *Erchomus* MOTSCHOULSKY, Bull. Soc. Imp. Nat. Moscou, vol. 31, pt. 3, p. 218.

1869. *Cilea* PANDELLÉ, Ann. Soc. Ent. France, ser. 4, vol. 9, p. 277. (Not J. DUVAL, 1857.)

Body broad; head inclined, not margined at the sides; antennae 11-segmented, feebly incrassate, inserted at the sides of the head; maxillary palpi filiform, last segment acuminate; labial palpi filiform, last segment longer; ligula bilobed; no ocelli; prosternum short; anterior tarsi 5-segmented, simple; anterior coxae conical, prominent; elytra longer than pronotum, generally extended beneath the body; mesosternum carinate; posterior coxae transverse, contiguous, free; first segment of hind tarsi moderate or short; tibiae fimbriate at tip with unequal spinules; abdomen feebly margined.

This is a large genus occurring throughout the world. In all, 181 species have been described from the New World, Europe, Africa, India, Australia, and the Philippine Islands.

KEY TO NORTH AMERICAN SPECIES OF COPROPORUS [2]

1. Pronotum punctate 2
 Pronotum not punctate 4
2. Elytra with a concavity at sides 3
 Elytra without a concavity at sides **lecontei**
3. Elytra coarsely punctate **ventriculus**
 Elytra exceedingly minutely punctate **infimus**

[2] The punctation of the pronotum and elytra is sometimes very minute and requires a high magnification to be visible. Under low power the surface irregularities may appear to be punctures.

4. Pronotum and elytra strigulose **inflatus**
 Pronotum and elytra not strigulose 5
5. Elytra with a distinct concavity at sides 6
 Elytra at most flattened at sides 7
6. Elytra distinctly punctate on disk **rutilus**
 Elytra not punctate on disk or very minutely and irregularly so **laevis**
7. Elytra distinctly punctate on disk **sparsus**
 Elytra not punctate on disk or very minutely so **arizonae**

COPROPORUS VENTRICULUS (Say)

1834. *Tachyporus ventriculus* SAY, Trans. Amer. Philos. Soc., vol. 4, p. 466.
1837. *Tachyporus acuductus* KIRBY, Fauna Boreali-Americana, vol. 4, p. 90.
1837. *Tachyporus affinis* KIRBY, Fauna Boreali-Americana, vol. 4, p. 91. (Not Sharp, 1883.)
1839. *Tachinus gibbulus* ERICHSON, Genera et species staphylinorum . . . , p. 252.
1840. *Tachinus ventriculus* (Say), ERICHSON, Genera et species staphylinorum . . . , p. 920.
1846. *Tachyporus punctulatus* MELSHEIMER, Proc. Acad. Nat. Sci. Philadelphia, vol. 2, p. 32.
1859. *Coproporus ventriculus* (Say), LECONTE, The complete writings of Thomas Say . . . , vol. 2, p. 583.
1877. *Erchomus ventriculus* (Say), HORN, Trans. Amer. Ent. Soc., vol. 6, p. 108.
1877. *Erchomus acuductus* (Kirby), HORN, Trans. Amer. Ent. Soc., vol. 6, p. 126.
1877. *Erchomus affinis* (Kirby), HORN, Trans. Amer. Ent. Soc., vol. 6, p. 126.
1877. *Erchomus gibbulus* (Erichson), HORN, Trans. Amer. Ent. Soc., vol. 6, p. 126.
1877. *Erchomus punctulatus* (Melsheimer), HORN, Trans. Amer. Ent. Soc., vol. 6, p. 126.
1884. *Erchomus flavidus* CASEY, Contributions to the coleopterology of North America, pt. 2, p. 141.
1915. *Erchomus politus* MANEE, Ent. News, vol. 26, p. 175. (Not Sharp, 1876.)

Color piceous; antennae, trophi, prosternum, and legs testaceous; frequently paler in great part. Head obtrapezoidal, abruptly truncated and declivous in front of the eyes; surface above not distinctly punctulate but extremely minutely wrinkled, shining; gula wide but somewhat narrowed at middle, slightly elevated and convex. Antennae short, gradually expanding, segments 6–11 transverse, eleventh subequal to ninth and tenth together. Maxillary palpi short, stout; fourth segment longer than third but less thick and feebly tapering. Pronotum shining, minutely and irregularly punctulate. Mesosternum feebly carinate posteriorly, minutely strigulose. Surface of elytra uneven, distinctly punctate; with a broad concavity along the lateral margin; epipleurae inflexed against inner face of elytra. Abdomen feebly margined; the feeble punctures indistinct because of the minute reticulations, above and beneath. Eighth tergite of male 4-lobed, lobes triangular, median pair a little longer; eighth sternite broadly semicircularly notched, this and the three preceding segments flattened at middle throughout their length.

Eighth tergite of female with four short blunt lobes, the median pair slightly longer, all separated by narrow triangular excisions, lateral pair a little broader; eighth sternite with four lobes, the median pair broadly rounded, separated by a semicircular notch, and with four spinules on each, outer lobes shorter and more pointed and each with two or three long setae, a rudimentary third pair of lobes marked by a pair of long black setae on the lateral margins.

Type locality.—Pennsylvania.

Localities represented.—New Hampshire, Vermont, Massachusetts, Connecticut, New York, Pennsylvania, New Jersey, Maryland, District of Columbia, Virginia, North Carolina, Georgia, Florida, Kentucky, Tennessee, Louisiana, Ohio, Michigan, Wisconsin, Minnesota, South Dakota, Iowa, Nebraska, Missouri, Kansas, Texas, New Mexico, Arizona, Nevada, California, Oregon, Washington, Ontario, Manitoba. Also recorded from Indiana and West Virginia.

Remarks.—The type of this species has undoubtedly been lost. The Horn collection in the Academy of Natural Sciences of Philadelphia contains specimens from Pennsylvania, Louisiana, Michigan, Florida, and Arkansas. The variability of this species has given rise to the lengthy synonymy. The five specimens of *E. flavidus* in the Casey collection are uniformly pale, but any large series of this species contains similar immature specimens. No identified specimens of *ventriculus* have been found in the Casey collection. *E. politus* Manee is represented in the collection of the writer by four specimens collected at the type locality by Manee. I am not able to separate these from a large series of *ventriculus*. The Horn collection contains a specimen labeled "*Erchomus politus* Manee n. sp. Type."

COPROPORUS RUTILUS (Erichson)

1839. *Tachinus rutilus* ERICHSON, Genera et species staphylinorum . . . , p. 253.
1855. *Tachyporus brevis* SCRIBA, Ent. Zeit. Stettin, vol. 16, p. 296. (Not Sharp, 1876.)
1859. *Coproporus rutilus* (Erichson), KRAATZ, Archiv für Naturg., vol. 25, pt. 1, p. 59.
1883. *Erchomus rutilus* (Erichson), SHARP, Biologia Centrali-Americana, Coleoptera, vol. 1, pt. 2, p. 304.
1924. *Cilea rutilus* (Erichson), WOLCOTT, Insectae Portoricensis, p. 79.

Rufopiceous to piceotestaceous; base of antennae, trophi, legs, and often the pronotum testaceous. Head transverse, triangular in front, not abruptly declivous; surface smooth and shining; gula wide but narrowed at middle. Antennae shorter than the head and prothorax, segments 8–10 transverse, eleventh broad and flat, as long as the two preceding together. Fourth segment of maxillary palpi longer than third, as large at base and evenly conical. Pronotum smooth, shining, impunctate. Mesosternum feebly carinate posteriorly. Elytra

smooth, shining, sparsely but relatively coarsely punctured; with a distinct longitudinal concavity at the middle of the side, not close to the margin; epipleurae free from inner face of elytra but inflexed far above the horizontal. Abdomen feebly margined, generally very much retracted; sparsely and indistinctly punctate throughout, with minute reticulations. Eighth tergite of male with four narrow lobes, the median pair longer and separated by a shallow rounded incisure; eighth sternite with a broad triangular notch, the angles prolonged. Eighth tergite of female with four slender lobes, the median pair a little longer, the outer pair each with a long black seta; eighth sternite with four blunt lobes, the middle a little longer and with three spinules at tip, the outer each with a long black seta.

Type locality.—Originally cited from "Americae ins. Puerto Rico et St. Thomae, in Columbia."

Localities represented.—Texas (Brownsville, Victoria, Columbus, Houston).

Remarks.—This species is common throughout Central America, northern South America, and the West Indies. It has not been previously recorded from the United States. *Tachyporus brevis* Scriba is included as a synonym on the authority of the Junk and Schenkling catalog.

COPROPORUS LECONTEI, new name

1863. *Coproporus punctipennis* LeConte, Smithsonian Misc. Coll., vol. 6, no. 167, p. 31. (Not Kraatz, 1859.)

1877. *Erchomus punctipennis* (LeConte), Horn, Trans. Amer. Ent. Soc., vol. 6, p. 107.

Black; antennae, trophi, and legs rufotestaceous. Head transverse, not abruptly declivous in front of the eyes; above impunctate, very minutely wrinkled, shining; beneath densely wrinkled; gula moderately wide and narrowed at middle. Antennae about as long as head and pronotum, feebly expanding distally but no segments transverse, eleventh equal to ninth and tenth together; finely pubescent from the fourth segment. Fourth segment of maxillary palpi longer than third, a little narrower at base than third and feebly conical. Pronotum minutely punctulate and very indistinctly and irregularly strigulose. Mesosternum carinate, carina elevated into a thin lamella nearly as high as long, abruptly terminated anteriorly. Surface of elytra uneven, finely and sparsely punctate, very indistinctly strigulose; sides without concavity except for a fine groove just at the edge; epipleurae free from inner face of elytra and nearly horizontal. Abdomen distinctly margined; sparsely punctured and strigulose above and beneath. Eighth tergite of male with four short equal triangular lobes, the middle pair separated by a rounded excision, laterals somewhat anterior; eighth sternite triangularly notched,

the notch slightly wider than deep, apex angular; seventh sternite very broadly and feebly emarginate throughout its width. Eighth tergite of female 4-lobed, the lobes long and slender, the median pair a little longer and separated by a narrow acute excision; eighth sternite with six lobes, the median pair longest and each bearing two spinules at tip, laterals blunt and each bearing a stout spine.

Type locality.—Valley of the Gila River, Ariz.

Lectotype.—Mus. Comp. Zool. no. 6497. Bears only a silver disk.

Localities represented.—Specimens have been seen also from Arizona (Tucson, Catalina Springs) and California (Hesperia, El Rio, Calaveras).

Remarks.—The three males in the Horn collection all have the sexual characters of *ventriculus*. The name used by LeConte for this species was preoccupied by Kraatz, who used it four years previously for a species from "India orientale."

COPROPORUS LAEVIS LeConte

1863. *Coproporus laevis* LECONTE, Smithsonian Misc. Coll., vol. 6, no. 167, p. 31.
1877. *Erchomus laevis* (LeConte), HORN, Trans. Amer. Ent. Soc., vol. 6, p. 108.

Piceous to piceotestaceous; antennae, trophi, and legs testaceous. Head transverse, not abruptly declivous, triangular in front; smooth, shining, impunctate; gula wide in front and at rear, narrowed behind the middle; ventral surface strigulose. Antennae not quite so long as head and prothorax together, with segments 8–10 transverse, the eleventh not quite so long as the ninth and tenth together. Maxillary palpi unusually long, fourth segment longer than the third, as large at base, conical. Pronotum smooth, shining, impunctate. Mesosternum moderately carinate posteriorly. Elytral surface uneven, but shining, impunctate except at the sides; sides with a distinct concavity at middle above the margin; epipleurae free from inner surface of elytra but inflexed far above the horizontal position. Abdomen feebly margined, surface strongly but sparsely punctate throughout, strigulose. Eighth tergite of male with four triangular lobes, the median pair more posterior, separated by a narrowly rounded excision; eighth sternite with a broad triangular notch, one-quarter wider than deep, angles prominent. Eighth tergite of female with four slender elongate lobes, the median pair a little longer, all separated by acute incisures; eighth sternite with six lobes, the median pair much longer, broad, and armed with three or four spinules at tip, lateral lobes descending, each bearing a large black seta at apex.

Type locality.—Southern States. (The type specimen bears a small pink square, apparently indicating "Middle States.")

Lectotype.—Mus. Comp. Zool. no. 6498. Bears only a small pink square.

Localities represented.—In the present collections are specimens from Florida, Maryland, Virginia, Louisiana, Tennessee, Ohio, District of Columbia, Alabama, Texas, and Kansas. It has been recorded from Mexico and Indiana.

Remarks.—This is the only species in our region that has the head, pronotum, and elytral disk totally devoid of punctation. It differs from *C. lecontei*, new name (*punctipennis* of LeConte), also in the development of the mesosternal carina, the lateral impression of the elytra, the inflection of the epipleurae, and minor characters of the eighth abdominal segment.

COPROPORUS SPARSUS, new species

Piceous; antennae, trophi, and legs testaceous. Head oval, slightly transverse, obtusely triangular in front; surface shining, impunctate above. Antennae not quite so long as head and prothorax, gradually expanded but only the ninth and tenth transverse, together as long as the eleventh. Gula broad, narrowed at middle. Maxillary palpi stout, fourth segment a little longer than third, about as large at base, conical. Pronotum smooth, shining, impunctate. Mesosternum moderately carinate posteriorly. Elytral surface uneven but shining, sparsely and irregularly but distinctly punctured; flattened at sides but not distinctly concave; epipleurae inflexed almost against the inner face of elytra. Abdomen feebly margined, strongly retracted, sparsely but coarsely punctured throughout, strigulate. Male unknown. Eighth tergite of female with four long, slender lobes, the median pair a little longer; eighth sternite with six lobes, the median pair longer and each bearing two curved spinules.

Type locality.—Fort Grant, Ariz.

Types.—Holotype (a female from Fort Grant, Ariz., 12.7, collection of Hubbard and Schwarz), U.S.N.M. no. 51076; one paratype (same data) in the collection of the writer.

This species was recognized as new by Schwarz and was so labeled by him in the Hubbard and Schwarz collection.

COPROPORUS INFLATUS (Horn)

1877. *Erchomus inflatus* HORN, Trans. Amer. Ent. Soc., vol. 6, p. 107.

Piceous to rufopiceous; base of antennae, trophi, and legs testaceous; elytra and sides of pronotum generally rufous. Head transverse, abruptly narrowed before the eyes but produced at middle and not declivous; surface shining but distinctly strigulose, impunctate; gula wide but strongly narrowed at middle, smooth and convex; sur-

face beneath strigulose. Antennae about as long as head and prothorax; segments 8–10 about as wide as long, eleventh not equal to ninth and tenth together. Maxillary palpi long and slender, last segment nearly twice as long as third, as large at base, freely conical. Pronotum shining, impunctate, but distinctly strigulose. Mesosternum strongly carinate. Elytra punctate[3] and strongly strigulose; not impressed at the sides; epipleurae free but inflexed far above the horizontal position. Abdomen feebly margined; coarsely but sparsely punctured throughout and strigulose. Eighth tergite of male with four slender lobes, the median pair longer and separated by a triangular incisure; eighth sternite with an acute triangular notch, about as wide as deep, angles produced into slender lobes. Eighth tergite of female with four long slender lobes, the median pair a little longer, all separated by acutely rounded excisions wider than the lobes; eighth sternite with six lobes, the two median pairs long and slender, the middle pair armed each with two curved spinules, the others bearing each a long black seta.

Type locality.—Camp Grant, Ariz.

Lectotype.—Acad. Nat. Sci. Philadelphia no. 3140. A male labeled "Ariz."

Localities represented.—Specimens from the following additional localities have been seen: Arizona (Tucson), California, and Texas.

Remarks.—This species is almost certainly involved in the synonymy of the tropical American species *flavipalpis* Sharp, *ventralis* Sharp, *gravidus* Sharp, *ignavus* Sharp, *rotundatus* Sharp, *elatus* Erichson, and *convexus* Erichson.

COPROPORUS ARIZONAE, new species

Piceous; antennae, trophi, legs, and sides of pronotum testaceous. Head transverse, triangular in front; smooth, shining, impunctate above; gula wide, but short and rapidly narrowed posteriorly. Antennae nearly as long as head and prothorax, segments not transverse, eleventh subequal to ninth and tenth together. Maxillary palpi stout, fourth segment slender, small at base and one-half longer than third. Pronotum shining, impunctate, but with exceedingly minute surface irregularities. Mesosternum strongly carinate posteriorly, the carina forming a thin lamella between the coxae and ending abruptly over the apex of the metasternum. Elytra shining, with surface slightly uneven, but not punctate;[4] without concavity at the sides, but generally flattened, especially posteriorly; epipleurae inflexed very close to inner face of elytra. Abdomen feebly margined; sparsely and

[3] The punctures are frequently obscured by the convergence of the strigulae.

[4] With low magnification the elytra appear to be minutely punctured, but with the highest magnification obtainable they are seen to be merely slightly uneven.

coarsely punctate throughout, reticulate. Eighth tergite of male with four blunt lobes, the outer pair twice as long as the inner but not extending as far posteriorly, separated from the inner pair by deep incisures and each bearing a long black seta, the inner pair separated by a very short notch and each bearing a short pale seta; eighth sternite with a large notch, nearly semicircular owing to obliteration of the apical angle, a little wider than deep. Eighth tergite of female with six lobes, the outer one-half as long as the intermediate, each bearing a short pale seta, incisures all narrow and deep; eighth sternite with six blunt lobes, the median each bearing two curved spinules, the lateral four each with a long black seta.

Type locality.—Cave Creek, Chiricahua Mountains, Ariz.

Types.—Holotype (a female from Chiricahua Mountains, Ariz., 24.5 (May 24, 1897), collection of Hubbard and Schwarz), and 31 paratypes, U.S.N.M. no. 51078; four paratypes in the collection of the writer; paratypes from same locality and also Santa Rita Mountains and Catalina Mountains, Ariz.

Remarks.—Thirty-six specimens of this species were segregated in the Hubbard and Schwarz collection as "*Erchomus* n. sp." One specimen also bears the label "*Erchomus convexus* Lec." in Schwarz's handwriting. This is probably a mistake for *convexus* Erichson, but that species is quite distinct. One specimen from west of Beaver, Devils River, Tex., and one from Cordova, Veracruz, Mexico, are doubtfully referred to this species. They are paler and larger but do not seem to differ structurally.

COPROPORUS INFIMUS (Duval)

1857. *Tachinus infimus* J. DuVal *in* Sagra's Historia fisica, politica y natural de la isla de Cuba, Coleoptera, p. 33.

1863. *Coproporus infimus* (DuVal), Chevrolat and Fauvel, Ann. Soc. Ent. France, ser. 4, vol. 3, p. 430.

1920. *Erchomus infimus* (DuVal), Leng, Catalog of the Coleoptera of America, north of Mexico, p. 111.

Piceous to piceotestaceous; antennae, trophi, legs, and apex of elytra paler. Head transverse, abruptly narrowed in front of the eyes but produced into a broad clypeal lobe between the antennae; shining, exceedingly minutely punctate; gula broader at base than apex but narrowed at anterior third; head beneath coarsely strigulose. Antennae about as long as head and prothorax, segments 7–10 transverse, eleventh about equal to ninth and tenth together. Pronotum smooth, shining, exceedingly minutely and sparsely punctured. Mesosternum feebly carinate posteriorly. Elytra smooth, shining, iridescent, very minutely and sparsely punctured similarly to the pronotum; sides explanate to form a broad marginal concavity extending throughout the length; epipleurae broad, free, and nearly horizontal.

Abdomen distinctly margined but generally much retracted and scarcely visible; moderately densely but not coarsely punctured throughout. Eighth tergite of male divided into three lobes, the median broad and feebly triangularly notched, the lateral pair with black setae; eighth sternite with a shallow triangular notch, two-thirds wider than deep, the angles rounded. Eighth tergite of female with four narrowed lobes, the median pair a little longer, the laterals bearing each a long black seta; eighth sternite with six lobes, the median four nearly equal, median two each bearing four spinules at tip; each lateral with a long black seta.

Type locality.—Cuba.

Localities represented.—This species has been found at the following localities in the United States: Florida (Crescent City, Biscayne, Indian River). It is a common Cuban species.

In the Hubbard and Schwarz collection this species was labeled by Schwarz as "*Erchomus* n. sp."

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DESCRIPTIONS OF NEW AND LITTLE-KNOWN FOSSIL LIZARDS FROM NORTH AMERICA

By CHARLES W. GILMORE

SINCE the appearance of my memoir entitled "Fossil Lizards of North America"[1] in 1928, the United States National Museum has acquired, either through purchase or from its various paleontological expeditions, a number of fossil lizard specimens. Some of these contribute to a better understanding of forms already known, while others are here described as new. The type of *Rhineura sternbergii* Walker is illustrated for the first time. All the illustrations have been made by Sydney Prentice.

Family AMPHISBAENIDAE

Genus RHINEURA Cope

The genus *Rhineura* as applied to extinct forms now includes the three species *R. hatcherii* Baur, *R. coloradoensis* Cope, and *R. sternbergii* Walker. A fourth species, *R. minutus*, is described below. All are from the Oligocene, *R. coloradoensis* being from the Chadron, the others from the Brule.

[1] Gilmore, Charles W., Mem. Nat. Acad. Sci., vol. 22, 1928.

RHINEURA MINUTUS, new species

FIGURE 1

Type.—U. S. N. M. no. 12158, consisting of the skull, lower jaws, 23 articulated vertebrae, and a few incomplete ribs. Collected by M. V. Walker, 1931.

Type locality.—A small badland area that is bisected by U. S. Highway No. 20, about 8 miles east of Douglas, Converse County, Wyo.

Horizon.—Lower nodular layer of the Brule, Oligocene.

Description.—The type specimen was found weathered out on the surface of a nodule. The skull of this specimen appears to be the smallest reptilian cranium that has yet been found in North America, measuring only 7.8 mm in length. It is thus slightly shorter than the type skull of *Rhineura sternbergii* (see fig. 2) and also is less robust in its other proportions. Both of these specimens were found at the same locality, and the small size of the National Museum individual led me at first to regard it as pertaining to *R. sternbergii.* Through the courtesy of George F. Sternberg, who loaned me the type, I was able to make direct comparisons of the two skulls, and differences were found that indicate that they pertain to distinct species.

From *R. sternbergii* the skull of *R. minutus* is distinguished by the less steeply arched profile, the absence of a distinct sagittal ridge, the absence of roughening on the frontal and parietal surfaces, narrower occipital region, slenderer maxillary, shorter precoronoidal part of jaw, and longer postcoronoidal part. All these differences are clearly seen by a comparison of figures 1 and 2.

From *R. hatcherii* Baur, known from the Brule formation of South Dakota and Nebraska, *R. minutus* is at once distinguished by its much smaller size, being about one-half the dimensions of the known skulls of that species. Furthermore, those characters enumerated above that distinguished it from *R. sternbergii* also serve to differentiate *R. minutus* from *R. hatcherii.*

The absence of a sagittal ridge on the parietal and supraoccipital and the lack of roughening of the frontal and parietal surfaces might suggest the juvenile character of the individual, if it were not for the fact that most of the skull sutures are so thoroughly coössified as to defy detection. It is concluded, therefore, that the type specimen is fully adult.

In profile the upper border is evenly rounded from front to back, differing in this respect from all known species of *Rhineura* both living and extinct that have the facial and occipital angles much more steeply inclined. This depression of the skull brings about a

narrowing of the maxillary as compared with *R. sternbergii*, approaching *R. hatcherii* more nearly in this respect.

Viewed from above (see fig. 1, B) the skull is more regularly elongate, with a relatively narrower occipital region than in any of the other known species. The paired frontals are deeply emarginate at the center, but their superior surfaces are perfectly smooth, not roughened as in *R. hatcherii* and *R. sternbergii*. The anterior parietal surface is flattened and gradually slopes off on either side, instead of being angular as in the other species. There is no trace of a median sagittal ridge more posteriorly, the surface rounding over evenly from side to side. There is faint indication of the sutural contact with the supraoccipital as shown in figure 1, B. None of the other sutures of the occipital region can be differentiated.

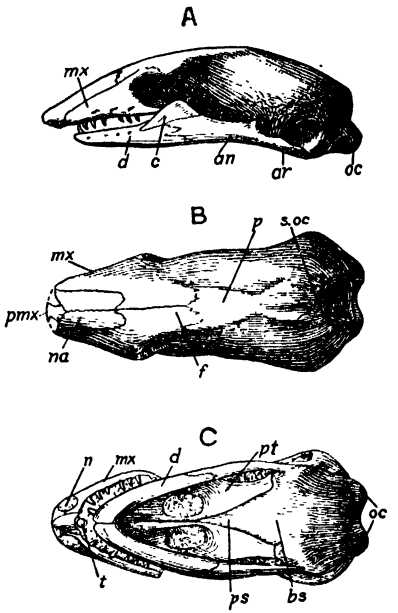


FIGURE 1.—Skull of *Rhineura minutus*, new species, type (U.S.N.M. no. 12158): A, Lateral view; B, dorsal view; C, ventral view. *an*, angular; *ar*, articular; *bs*, basisphenoid; *c*, coronoid; *d*, dentary; *f*, frontal; *mx*, maxillary; *n*, external nares; *na*, nasal; *oc*, occipital condyle; *p*, parietal; *pmx*, premaxillary; *ps*, presphenoid; *pt*, pterygoid; *s.oc*, supraoccipital; *t*, premaxillary tooth. Five times natural size.

The nose is slightly incomplete, as the thin part of the nasal bones forming the covering for the nares is eaten away, and in figure 1 it has been restored after Carnegie Museum specimen no. 423A. Unfortunately, only a few of the sutures separating the individual elements can be distinguished.

Since the premaxillary is complete only at the center, its lateral extent cannot be certainly determined. On the ventral surface it bears a single tooth (see fig. 1, C), as in the other species. Its posterior extent between the nasals is not certainly determined as shown in the illustrations.

The maxillary carries six small, sharply pointed teeth. It is triangular in outline, relatively narrower and slenderer in front than the maxillary of *R. sternbergii*. A row of small foramina extends along the lower edge parallel with the alveolar border. About midway of the length of the maxillary the three anterior teeth are separated by a considerable space from the posterior three. This same arrangement prevails in *R. sternbergii* but not in specimens of *R. hatcherii*.

The nasals are as in *R. sternbergii* but relatively shorter.

The frontals are differentiated only by the median and posterior sutures. The posterior median line is less deeply indented by the parietals than in *R. sternbergii.*

The posterior extent of the parietal and its union with the supraoccipital are faintly indicated as shown in figure 1, B. This surface shows no indication of a sagittal ridge, which forms such a prominent feature of the other species.

In the palatal view none of the sutures can be determined; the upward pitch of the basisphenoid and parasphenoid surfaces is less pronounced than in *R. sternbergii.* The posterior limits of the large scalelike pterygoids can be clearly determined as shown in figure 1, C. Their junction with the palatines, however, is fully coalesced and cannot be determined. The anterior palatal region is hidden by the articulated lower jaws and is therefore not available for study.

Lower jaws.—The lower jaws remained in an articulated state, but only the dentary and coronoid sutures show clearly, all others being fused. Compared with the ramus of *R. sternbergii*, the jaw is slenderer and the coronoid has a more anterior position, thereby making the postcoronoidal part of the ramus considerably longer. The number of teeth in the lower jaw cannot be determined from this specimen.

TABLE 1.—*Comparative measurements of skulls of* Rhineura

Measurement	*R. minutus* U.S.N.M. no. 12158 (type)	*R. sternbergii* (type)	*R. hatcherii* P. M. no. 11309 (type)
	Mm	*Mm*	*Mm*
Greatest length at center	7. 8	8. 0	13. 5
Greatest width across squamosals	3. 3	4. 0	5. 7
Greatest width across orbits	2. 9	3. 0	4. 0
Least width of brain case	1. 6	1. 75	3. 2
Length of lower jaw	5. 0	4. 1	8. 75
Space occupied by upper teeth	2. 0	2. 0	3. 3

Vertebrae.—There are 23 articulated vertebrae preserved with this specimen. The anterior end of the series was in contact with the skull. The first two vertebrae, however, are damaged, and they cannot be positively identified as being the atlas and axis. In fact, the absence of hypapophyses indicates that a few vertebrae may be missing from the anterior end of the series. Except for their very much smaller size, I am unable to detect any features that would distinguish these vertebrae from those of *R. hatcherii* which I have previously described.[2] The series has a greatest length of 31 mm.

[2] Mem. Nat. Acad. Sci., vol. 22, p. 43, 1928.

RHINEURA STERNBERGII Walker

FIGURE 2

Rhineura sternbergii WALKER, Trans. Kansas Acad. Sci., vol. 35, p. 225, 1932.

This species was established by M. V. Walker on a beautifully preserved skull and lower jaws, with the sutures plainly discernible; thus most of the skull elements can be fully differentiated.

Walker gave a most complete and thorough description of the type specimen, but without illustrations. Through the courtesy of George F. Sternberg, in whose private collection the specimen belongs, I am now enabled to present for the first time two views (fig. 2) of this interesting specimen.

This species was distinguished from *R. hatcherii* as follows: "Viewed from the side, the skull of *Rhineura sternbergii* differs from *R. hatcherii* in being proportionately longer in the facial angle, and proportionately shorter in the occipital angle. In other words, the slightly rounded ascending facial angle of *R. sternbergii* continues to a point considerably posterior of the point at which it turns and descends in *R. hatcherii*. The skull thus appears more highly arched, proportionately, than in *R. hatcherii* * * *. The nasals are proportionately much longer in *Rhi-*

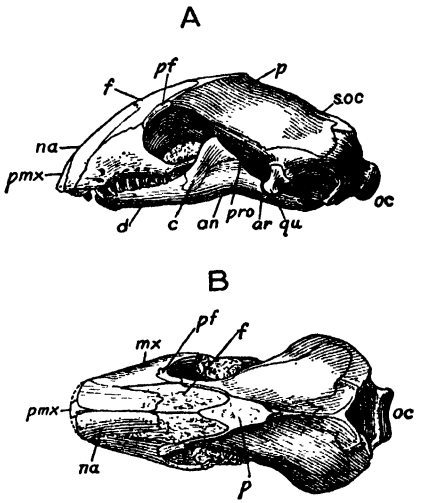


FIGURE 2.—Skull and lower jaws of *Rhineura sternbergii* Walker, type: A, Lateral view; B, dorsal view. *an*, angular; *ar*, articular; *c*, coronoid; *d*, dentary; *f*, frontal; mx, maxillary; *na*, nasal; *oc*, occipital condyle; *p*, parietal; *pf*, prefrontal; *pmx*, premaxillary; *pro*, prootic; *qu*, quadrate; *s.oc*, supraoccipital. Five times natural size.

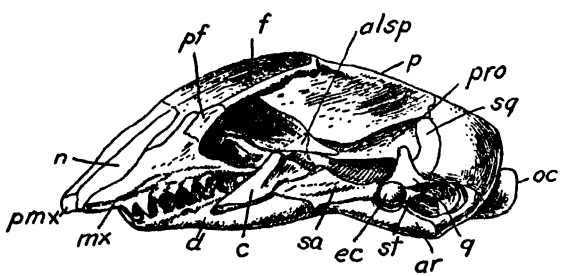


FIGURE 3.—Skull of *Rhineura hatcherii* Baur (Carnegie Museum no. 423A) viewed from the left side. *alsp*, alisphenoid; *ar*, articular; *c*, coronoid; *d*, dentary; *ec*, extra columella; *f*, frontal; *mx*, maxillary; *n*, nasal; *oc*, occipital condyle; *p*, parietal; *pf*, prefrontal; *pmx*, premaxillary; *pro*, prootic; *q*, quadrate; *sa*, surangular; *sq*, squamosal; *st*, stapes. Four times natural size. After Gilmore.

neura sternbergii, and the superior process of the premaxillary extends much farther posteriorly between the nasals. The maxillary is less triangular and more rounded anteriorly. The precoronoidal part of the dentary is shorter than the postcoronoidal portion. Also, the most anterior process of the coronoid terminates slightly behind the last tooth."

When direct comparison of the original skulls of *R. sternbergii* and *R. hatcherii* is made, the supposed difference in the facial and occipital angles of the skulls largely disappears, as may be clearly seen by comparing figures 2 and 3. The steeper premaxillary region in *R. sternbergii* makes the nose of this species much blunter than in *R. hatcherii* and *R. minutus*.

The other characters used by Walker for differentiating *R. sternbergii* are as stated by him and effectually distinguish the species.

Family ANGUIDAE

Genus GLYPTOSAURUS Marsh

GLYPTOSAURUS GIGANTEUS Gilmore

FIGURE 4; PLATE 1

Glyptosaurus giganteus GILMORE, Mem. Nat. Acad. Sci., vol. 22, p. 119, pl. 14, fig. 1, 1928.

The acquisition by the United States National Museum of two well-preserved specimens referable to the little-known *Glyptosaurus giganteus* is of interest in contributing to a better understanding of this species. The type specimen, Carnegie Museum no. 1471, consists of the frontal portion of the skull, covered on its superior surface with osseous dermal scutes. Although this fragmentary specimen displayed minor distinctive characteristics, its large size was the principal distinguishing feature.

The most complete specimen, U.S.N.M. no. 13869, consists of the almost complete skull and lower jaws to which is attached, *in situ*, a considerable portion of the dermal scuta that form the protective armor of the neck and the forward portion of the body (see pl. 1). In this latter respect it is the most complete specimen of a *Glyptosaurus* that has yet been discovered and the first to give an adequate conception of the arrangement of the dermal scuta on the anterior part of the animal.

The second specimen, U.S.N.M. no. 13861, consists of a nearly complete skull with the articulated ramus of the right side. Both of these specimens were collected in 1935 by George F. Sternberg from the Brule formation (Oreodon beds) of the Oligocene, about 8 miles southeast of Douglas, Converse County, Wyo.

Skull.—Both skulls lack their premaxillaries, but otherwise the crania are fairly complete. Since the skulls have much of their outer surfaces covered with tuberculated scuta, there is but little of the structure, aside from the palate, to be observed. The skull of this species is blocklike, broad across the parietals, and gradually narrowing from the back of the orbits forward. In profile there is a sag in the forward parietal region, but from a point above the center of the orbit the superior surface curves regularly downward to the nose. The central part of the frontonasal region of the skull is transversely hollowed out.

The entire external surface of the skull, except for a narrow strip paralleling the dental border of the maxillae, is covered by tuberculated osseous scuta. From a study of both skulls it has been possible to work out the extent and arrangement of nearly the entire scutellation, as shown in figure 4.

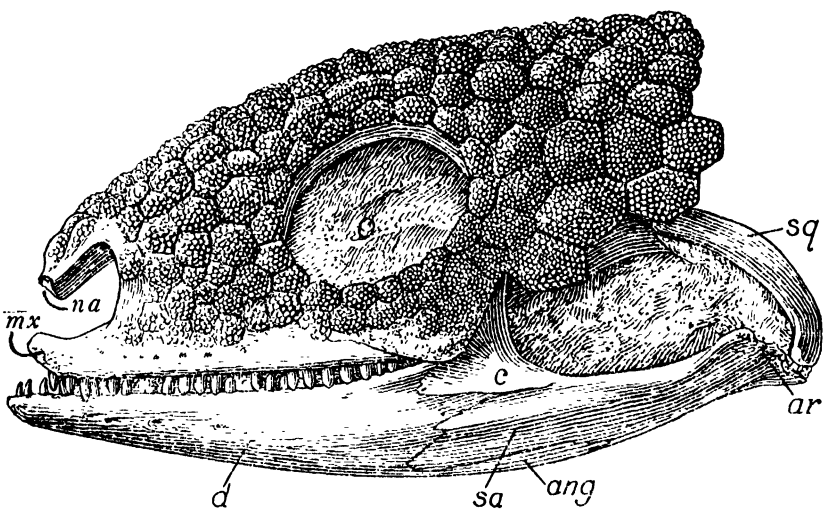


FIGURE 4.—Skull and lower jaw of *Glyptosaurus giganteus* Gilmore: Lateral view of U.S.N.M. no. 13869; scutellation restored from opposite side and from specimen U.S.N.M. no. 13861. *ar*, articular; *ang*, angular; *c*, coronoid; *d*, dentary; *mx*, maxillary; *na*, nasal; *o*, orbit; *sa*, surangular; *sq*, squamosal. Natural size.

Comparison of the scutellation of the top of the two skulls shows considerable variation in the sizes of the scutes, though their general arrangement is much the same in both specimens. Those of U.S.N.M. no. 13861 are the coarser and in that respect approach nearest to the type specimen with which it has been directly compared. On the dorsal side the scutes are arranged in irregular longitudinal rows, becoming more regular in their arrangement above the orbits. In this species the scutes have angularly convex upper surfaces, which

are thickly studded with small tubercles without definite arrangement. On the sides of the skull posterior to the orbit the scutes are arranged in longitudinal rows, and they gradually increase in size from above downward, more especially on the posterior half of the skull. The form of their upper surfaces also changes from the highly convex to nearly flat surfaces with the tubercles arranged in three to four concentric rows around the periphery of the scute, the center being filled with smaller tubercles without definite arrangement. The tubercle pattern is similar to that of the type specimen of *G. ocellatus* Marsh, which is now regarded as a synonym of *G. sylvestris*.[3] This specimen thus offers further proof of the correctness of that conclusion.

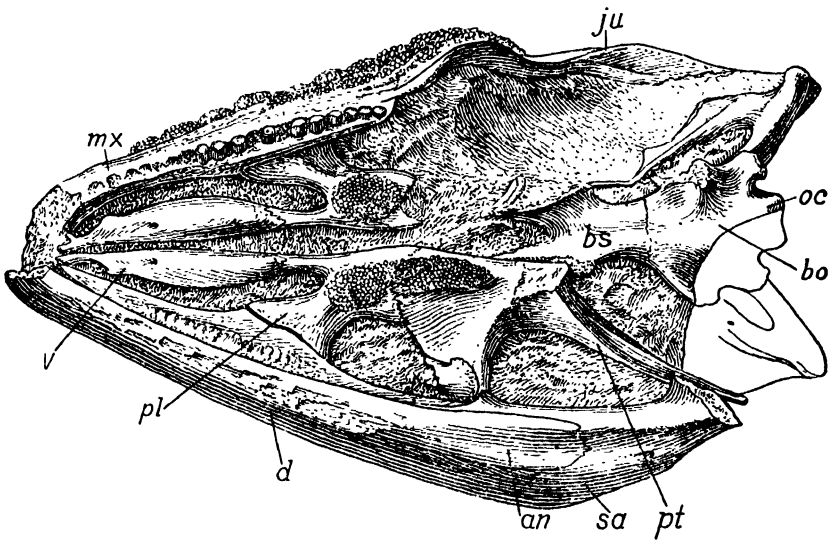


FIGURE 5.—Palatal view of skull and jaw of *Glyptosaurus giganteus* Gilmore: U.S.N.M. no. 13861. *an*, angular; *bo*, basioccipital; *bs*, basisphenoid; *d*, dentary; *ju*, jugal; *mx*, maxillary; *oc*, occipital condyle; *pl*, palatine; *pt*, pterygoid; *sa*, surangular; *v*, vomer. Natural size.

The orbit is encircled by a complete row of 17 or more scutes. Douglass found 20 surrounding the orbit of *G. montanus*. In the top of the right orbit of U.S.N.M. no. 13869 is a row of six scutes that completely covers the projecting edges of the postfrontal, frontal, and prefrontal bones and corresponds in position to the row of five supraorbital plates in *Gerrhonotus* or the lesser number in *Peltosaurus*.

In front of the orbit the scutes grow progressively smaller from above downward and cover all the bone surfaces except a 3-millimeter strip along the lower edge of the maxillary. All known *Glyptosaurus*

[3] Mem. Acad. Nat. Sci., vol. 22, p. 99, 1928.



GLYPTOSAURUS GIGANTEUS GILMORE

Skull and dermal armor. U. S. N. M. no. 13869. First specimen found that shows the dermal armor covering the neck in its natural articulated arrangement. About one-half natural size.

specimens show this strip to be free of osseous scutes, nor have any been found attached to the lower jaws. There is a tendency for these cranial scutes to fuse with the underlying bones. The fusion or nonfusion of the scutes is probably largely determined by the age of the individual.

Palate.—The palatal region of U.S.N.M. no. 13861 is quite complete, lacking only the left pterygoid and portions of the basioccipital and basisphenoid, and for the first time gives an adequate conception of the palatal structure in the genus *Glyptosaurus* as shown in figure 5.

Most of the occipital condyle and the processes are missing from the basioccipital. It is coossified by a straight transverse suture with the basisphenoid. The basipterygoid gives off two wide divergent processes near its anterior termination for articulation with the pterygoids. These are relatively shorter than in *Peltosaurus*. The pterygoid extends forward and inward from the quadrate with which it was in contact. Forward of its contact with the basisphenoid, the inner border continues straight forward to the palatine. On the inner side of the ventral surface, beginning immediately in advance of the pterygoid-basisphenoid articulation, is an elongated narrow patch of so-called pterygoid teeth. These teeth are tubercular, closely and irregularly crowded together, and collectively resemble the pattern on some of the dermal scutes (see fig. 5).

The palatine bone is short, with a bifurcated anterior end, the outer branch articulating with the inner side of the maxillary, the inner branch with the vomer. Much of the palatal surface is covered by a rounded patch of palatine teeth. These tubercular teeth are similar in form and distribution to those of the pterygoid, differing only in the extent and shape of the aggregation, which is shorter and more rounded than the long narrow patch on the pterygoids. In the presence of patches of toothlike structures on both the pterygoids and palatines *Glyptosaurus* closely resembles *Melanosaurus* of the Wasatch. The presence of patches of tooth structures on both pterygoid and palatine bones shows that I was in error in ascribing all fragmentary parts having tooth patches in *Glyptosaurus* to the pterygoids.[4] In my figures the rounded shape of the tooth patches shows them to be palatine, not pterygoid, as erroneously designated.

The vomers are separated from one another along the median line except toward their anterior ends. They are elongate, with rounded swollen palatal surfaces. The posterior end is reduced to a slender rod that articulates with the inner anterior branch of the palatine. There is no indication of vomerine teeth, though they are present in the related *Melanosaurus*. They are also absent in *Peltosaurus*.

[4] Mem. Nat. Acad. Sci., vol. 22, pl. 15, figs. 4, 8; pl. 19, fig. 10, 1928.

Lower jaws.—The sutures in the three rami under consideration are clearly determinable, but the arrangement and extent of the separate elements show no characteristics that would in any way distinguish them from the other species of the genus. Since the structure of the ramus in *Glyptosaurus* has been quite fully described [5] it is unnecessary here to enter into further details.

TABLE 2.—*Measurements of skulls and jaws of* Glyptosaurus giganteus

Measurement	U.S.N.M. no. 13861	U.S.N.M. no. 13869
Skulls	*Mm*	*Mm*
Greatest length of skull, about	128	
Greatest width of skull, across parietal	54	58
Greatest width of skull, between orbital borders	34. 5	36
Greatest height of skull	41. 5	
Greatest height of skull with mandible	58	60
Anteroposterior diameter of orbit	24	24
Vertical diameter of orbit	20. 5	19
Jaws		
Greatest length of ramus, about	112	108
Depth of ramus at posterior end of tooth row	15	14
Depth of ramus at anterior end of tooth row		6
Depth of ramus posterior to coronoid	12	11
Transverse width middle of tooth series	9. 5	11. 5
Transverse width between coronoid and cotylus	15	3
Greatest transverse diameter across articulated rami		56

Dermal scutes.—The osseous dermal scutes of *Glyptosaurus* that surround the neck and anterior part of the body are beautifully preserved in U.S.N.M. no. 13869 (see pl. 1). These are arranged in transverse and longitudinal rows, parts of 15 transverse rows being present in this specimen and little disturbed from their normal placement. The transverse rows of rectangular scutes immediately posterior to the skull cover the dorsal surface, the right side, and the region under the throat. More posteriorly, however, the scutes are missing on the ventral surface, as are most of those on the left side. With the exception of the scutes forming the median dorsal row, the others are nearly all rectangular in shape. The first two rows posterior to the skull are about as long as wide, whereas those that follow are nearly twice as long as wide. The scutes are closely joined by their lateral edges, and their ends are imbricated, the extent of the imbrication indicated by a smooth transverse band across their anterior ends. In the few scutes where the anterior end is exposed this smooth band is very narrow, measuring about one-sixth the total length of the scute. It is quite evident that this overlap is much

[5] Mem. Nat. Acad. Sci., vol. 22, pp. 110, 111, 1928.

greater in other parts of the animal, since scattered scutes found with other specimens show this smooth band to be one-fourth the total length of the scute.

The exposed surfaces of all the scutes are thickly studded with rounded tubercles. Those on the margins are usually arranged in two or more concentric rows. The tubercles inside these outer rows are usually smaller and without definite arrangement, except that there is a tendency in some scutes to form subcircular rows around the low nodelike carina that occurs on the posterior dorsal surface. Except on the median dorsal row the carina is always placed nearer to the inner than to the outer side of the scute. This fact would enable one to segregate scattered scutes into the right and left series.

The ventral scutes have the same rectangular shape, but they are distinguished from those described above by their smaller size, absence of a carina, and less prominently developed tubercles without definite arrangement. Since the anteriormost rows of the ventral scutes preserved cover the posterior end of the ramus, it seems quite probable that in life they continued farther forward under the jaws.

The scutes of the median dorsal row differ from the others in being wedge-shaped, wider in front than behind, and the low nodelike carina centrally placed on the posterior half. Slight disarrangement renders the count a little uncertain, but there appear to be 14 longitudinal rows of scutes, enumerating from the median dorsal row to the midventral region. This would indicate the complete circumference as being composed of 29 longitudinal rows of plates at a point immediately posterior to the skull.

With the discovery of more and better-preserved specimens, it becomes more and more apparent that in the genus *Glyptosaurus* the tubercular patterns on the scutes are of little assistance in taxonomy. Such differences as have been used in the past are found to be valueless from the fact that this ornamentation varies with the position of the scute on the body. Therefore until their limitations are known they will be of little use in characterizing species.

The cranial scutes, on the other hand, appear to show definite differences, although, as indicated by the two specimens now before me, there is considerable individual variation that must be always taken into consideration.

Genus PELTOSAURUS Cope

PELTOSAURUS species

In 1928 I referred[6] three incomplete dentaries from the Fort Union, Paleocene of Montana, to the genus *Peltosaurus*, but without

[6] Mem. Nat. Acad. Sci., vol. 22, p. 137, 1928.

specific designation. A fourth specimen, U.S.N.M. no. 10920, consisting of an incomplete left maxillary containing a few teeth, has now turned up in the collections. This specimen was also collected by A. C. Silberling in 1908, in Sec. 4, T. 5 N., R. 16 E., Sweetgrass County, Mont. In size and in all other particulars, insofar as they can be compared, this maxillary and teeth are in full accord with those of *Peltosaurus granulosus*, with which they have been directly contrasted. In view of their much earlier geological occurrence, I am loath to assign them to the Oligocene species, as in all probability more complete specimens would show their specific distinctness. For the present, therefore, I shall continue to regard these specimens as specifically undeterminable.

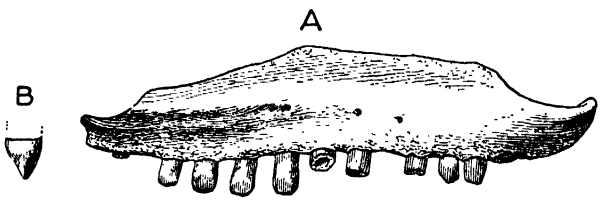


FIGURE 6.—Right maxillary of ? *Xestops piercei*, new species, type (U.S.N.M. no. 13807): A, Lateral view; B, posterior view of tooth. Five times natural size.

Genus XESTOPS Cope

? XESTOPS PIERCEI, new species

FIGURES 6, 7

Type.—U.S.N.M. no. 13807, consisting of both maxillae, anterior ends of both dentaries with numerous upper and lower teeth, and many dermal scutes. Collected by George B. Pierce, 1935.

Locality.—About 6 miles north of Tuttle Ranch, Elk Creek, Big Horn Basin, Big Horn County, Wyo.

Horizon.—Graybull formation, Wasatch, Eocene.

Description.—All the bones comprising the type specimen were found cemented together in a compact mass by the iron-stone covering so commonly found adhering to Wasatch fossils. It is quite evident that originally the entire skull had been present, as the maxillae and dentaries are little disturbed from their normal relationships, the whole top of the skull having been eroded away.

The right maxillary is complete in length, but the left one lacks a small portion of its anterior end. The right maxillary has the usual triangular outline, being deeply emarginated toward the upper anterior end and thus forming much of the lower and posterior borders of the external narial opening. The external surface of the bone is smooth, with only slight indication of the former presence of osteo-

derms, which probably covered much of the surface, as in the related *Glyptosaurus*, *Melanosaurus*, and *Peltosaurus*. This bone is perforated by the usual row of foramina.

The precise number of teeth in the maxillary cannot be determined from this specimen. There is evidence of 13, but at least 3 more would be required to fill the space hidden by the overlapping of the dentary upon the anterior alveolar border. The teeth are pleurodont, robust, and extend well below the parapet of the maxillary. The apices are bluntly wedged-shaped, with the cutting edge running longitudinal. The outer beveled surface is much shorter than the inner slope. Anterior and posterior sides of the teeth are flattened and closely placed in the series (see fig. 6). In a 10-millimeter space there are 12 teeth, whereas in *Melanosaurus maximus*, also from the Wasatch, 4½ teeth occupy an equal space. The related *Peltosaurus* is intermediate in this respect, having 8 teeth in a 10-millimeter space. The crowns are parallel-wrinkled, usually at right angles to the cutting edge. The right maxillary has a greatest length of 14.3 mm. Except that the maxillary teeth become smaller at the ends of the series, all seem to be very similar.



FIGURE 7.—Two dermal scutes of ? *Xestops pierceí*: Type (U.S.N.M. no. 13807). Five times natural size.

The few anterior teeth of the dentary that are present appear slenderer and extend relatively higher about the parapet than in the maxillary series.

The few dermal scutes found with this specimen are keelless, but it may be that all these pertain to the underparts of the skull and neck, and these are usually without carinae. With the exception of the narrow smooth band on the anterior end, for the overlap of the next adjoining scute, the dorsal surfaces are sculptured by a series of pits sparsely placed and without regular arrangement, as shown in figure 7.

One of the scutes has a beveled lateral edge, a condition previously observed [1] only in the genus *Xestops*. The presence of this type of scutellation and close resemblances of the dentition to that of *Xestops vagans* strongly suggest that the affinities of this new species lie in the genus *Xestops*, to which it is now provisionally referred.

[1] Mem. Nat. Acad. Sci., vol. 22, p. 145, 1928.

The presence of dermal scuta and pleurodont teeth, closely set with swollen obtuse summits, indicates the affinities of *Xestops pierce*i to lie in the family Anguidae.

From *Xestops vagans* this species is distinguished by its much smaller size and by the pitted character of the dermal scutes. The other species of the genus are all based on inadequate specimens and all are doubtfully referred, and in all probability they pertain to other genera. Their retention in *Xestops* has simply been a matter of expediency, and contrasting the present specimen with them would be of little significance.

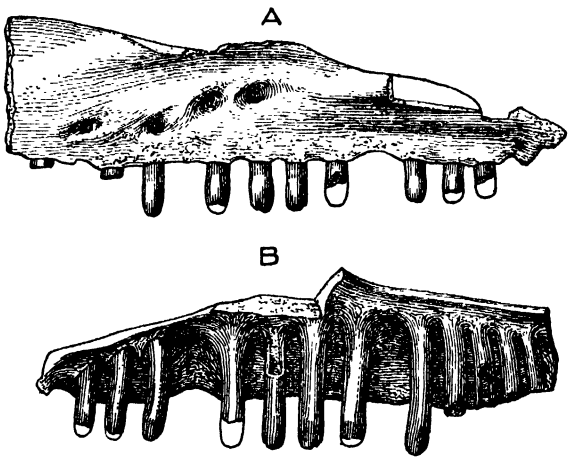


FIGURE 8.—Left maxillary of ? *Harpagosaurus silberlingii*, new species, type (U.S.N.M. no. 13877): A, External view; B, internal view. Five times natural size.

SAURIA OF UNKNOWN FAMILY REFERENCE

Genus HARPAGOSAURUS Gilmore

? HARPAGOSAURUS SILBERLINGII, new species

FIGURE 8

Type.—U.S.N.M. no. 13877, consisting of the greater portion of a left maxillary containing whole or parts of 12 teeth. Collected by A. C. Silberling, 1908.

Type locality.—Sec. 4, T, 5 N., R. 16 E., Sweetgrass County, Mont.

Horizon.—Fort Union No. 2, Paleocene.

Description.—The type maxillary lacks a portion of its anterior end, and only 5 of the 12 teeth have their complete crowns preserved as shown in figure 8.

The teeth, of which there is evidence of 14 in all, are pleurodont, with long shafts, rounded on the internal side but flattened on both

anterior and posterior sides. The crowns have an obtuse longitudinal cutting edge that is rounded anteroposteriorly. One tooth near the middle of the series presents a small denticle, anterior to the center of the cutting edge.

The crowns, except those of the most posterior teeth, which are shorter, curve slightly inward. In the center of the dental series there are 5½ teeth in a space of 5 millimeters.

Similarity of the emplacement of the teeth strongly suggests relationship with the genus *Harpagosaurus*, to which it is provisionally assigned. This species is distinguished from *Harpagosaurus exidens*, which occurs in these same beds, and also from *H. parvus* of the Lance formation by its much larger size, spatulalike form of the tooth crowns, and their longer protrusion below the parapet of the maxillary. Likewise these spatulalike teeth at once distinguish it from the wedge-shaped crowns of *Peltosaurus* sp., which also occurs in the Fort Union No. 2.

The species name is in honor of A. C. Silberling, who collected the type as well as many other specimens now in the National Museum collections.

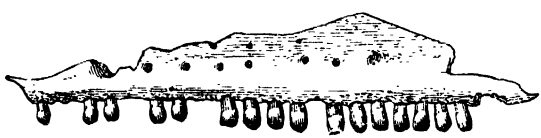


FIGURE 9.—Left maxillary of *Paraprionosaurus wyomingensis*, new species: Type (U.S.N.M. no. 12955), lateral view. Five times natural size.

PARAPRIONOSAURUS, new genus

PARAPRIONOSAURUS WYOMINGENSIS, new species

Type.—U.S.N.M. no. 12955, consisting of a nearly complete left maxillary, containing 16 perfect teeth. Collected by Charles W. Gilmore, 1931.

Type locality.—Two miles north of Lone Tree P. O., Bridger Basin, Uinta County, Wyo.

Horizon.—Horizon D, Bridger, Eocene.

Description.—The type specimen consists of a nearly perfect left maxillary, with 16 teeth *in situ*, and there is evidence of 23 teeth in the complete dental series. This specimen is preserved attached to a small block of matrix and for fear of doing irreparable damage to it removal has not been attempted, and for that reason the internal side is not available for study at this time. It is presumed that the teeth are pleurodont in the manner of attachment to the maxillary. There are 9½ teeth in a space of 5 millimeters.

The distinctness of the present form is indicated by the character of the dentition. The great number of teeth (23) in the maxillary series, their uniformity in shape and size, transversely compressed crowns, and cutting edges angularly rounded anteroposteriorly distinguish this specimen from all other extinct North American lizards.

In the regularity of size of the maxillary dentition, this specimen resembles *Prionosaurus regularis* from the Lance of Wyoming, but the more transversely compressed and spatulalike tooth crowns and slightly larger size distinguish it. The name *Paraprionosaurus wyomingensis* is therefore proposed for it. No clue of its family relationships has been detected from this scanty specimen.

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THE CAMBALOID MILLIPEDS OF THE UNITED STATES, INCLUDING A FAMILY NEW TO THE FAUNA AND NEW GENERA AND SPECIES

By H. F. Loomis

INTRODUCTION

It is being recognized that the Pacific Coast States, particularly California, have a larger and more varied milliped fauna than is to be found in any like area of the Eastern United States. Indeed, it is possible that there are not more species of millipeds in the entire region east of the Mississippi River. Because of the more accessible territory and the proximity of interested workers, the millipeds of the Eastern States naturally were subjects of study and, as a group, became fairly well known much earlier than did the western ones. Several of the principal papers on millipeds by Wood, Bollman, and Cook and Collins, while national in scope, nevertheless were based primarily on eastern forms, as these were known in much greater abundance; and to this day the majority of papers on western millipeds have consisted of disconnected descriptions of species with scarcely any attempts at treatment of genera or larger groups, and only one or two lists of species in geographic or political areas have appeared. Such papers give some indications of the numbers of millipeds to be found in the West, but in several recent papers[1] the preponderance of western species has been shown more forcibly in direct comparison with the eastern species, and this preponderance is manifest in the present study and others in preparation.

[1] Cook, O. F., and Loomis, H. F., Millipeds of the order Colobognatha, with descriptions of six new genera and type species, from Arizona and California, Proc. U. S. Nat. Mus., vol. 72, art. 18, pp. 1–26, 1928. Loomis, H. F., New millipeds of the American family Striariidae, Journ. Washington Acad. Sci., vol. 26, pp. 404–409, 1936. Loomis, H. F., Crested millipeds of the family Lysiopetalidae in North America, with descriptions of new genera and species, Proc. U. S. Nat. Mus., vol. 84, pp. 97–135, 1937.

The reason for such differences as exist between the number of millipeds of the two sides of the country may be understood from an examination of the environmental requirements of the animals. The limitations that confine groups of creatures to certain sets of conditions vary enormously; some have limitations so lightly drawn that they may inhabit great areas, while others may be restrained from spreading by more rigid requirements. The limitations imposed on the millipeds, and similar humus inhabitants, are especially restrictive, for their movements generally are held to localities having very uniform and constant supplies of food and moisture, or to areas in which they may move about following or keeping within such conditions. A few of the larger millipeds have been able to adapt themselves to semiarid or even arid regions, as the heavily armored, protective covering of their bodies allows greater freedom of movement in the open, above ground, but even these species require some natural protection, and where this is not provided by a humus layer they retreat into deep crevices in the soil or rocks, or into the burrows of other animals, and there spend much of their time. By far the largest number of species are definitely humus inhabitants, delicate creatures, most of them unable to withstand a few moments of hot sunshine or somewhat longer exposure to extreme dryness, whether above or below ground.

Throughout the Eastern States, with their more general rainfall, lower elevation, and abundant deciduous forests, humus conditions occur frequently and over considerable areas, so that intermigration and wide distribution of the humus fauna are possible. In the Western States the rainfall is less uniform; many regions have long seasonal droughts, others are arid deserts; the country is much more mountainous and has higher elevations, and the forests are predominantly coniferous, so that satisfactory humus conditions are generally of smaller extent and more definitely separated than in the East, and examples of isolation and limited distribution among the millipeds are the common rule. While there are many species of restricted distribution in the East, there also are many examples of widespread species, such as *Arctobolus marginatus*, *Polyzonium bivirgatum*, *Spirostrephon lactarium*, and *Polydesmus serratus*, to name but a few. From the literature on millipeds of the West and the collecting that has been done there exceedingly restricted distribution for most of the species is indicated, and none has been found that can be compared to the widely distributed eastern species.

Frequently a few miles separate different but closely related species of western millipeds, and the evidence points to the fauna being chiefly residual, descended in a large number of more or less iso-

lated localities from a common and widespread ancient fauna, as in the eastern region. That the climatic and other changes that separated and restricted different parts of the western fauna occurred very long ago is shown by the many closely related species that have been found, for evolutionary changes sufficient to establish species undoubtedly take places more slowly in animals living under uniform conditions, as do the millipeds, than in animals whose environment is less stable. The relatively large number of generally small but closely related genera among the western millipeds is still better proof of the long isolation that has existed between parts of the fauna, for a still greater length of time is required for the accomplishment of changes of such magnitude as require generic recognition.

The 20 species of millipeds of the suborder Cambaloidea found in the United States are arranged in 12 genera, of which 9 are monotypic and 3 each contain three or four species. Of these 12 genera, 9, containing 11 species, are strictly Californian; another genus of four species has three of them in California and one in Utah; one monotypic genus is confined to Tennessee; and last is the genus *Cambala*, most widely distributed of the American group, with its four species scattered through many of the Eastern States, Texas, and Arkansas. Thus, approximately three-fourths of the members of this suborder are limited to the relatively very small area of California, while all the rest of the United States contributes only one-fourth to the population of the suborder.

The material examined in the preparation of the present paper was collected principally by Dr. O. F. Cook, with a lesser amount collected by the writer and several of his friends. Most of the material plainly belonged to the family Cambalidae, but also included were four species, apparently new, that it has been necessary to refer to the Cambalopsidae, a family associated with India and the Malayan region and hitherto unknown in the Western Hemisphere. The wide removal of the American from the Asiatic branch of this family is, at present, lacking definite proof for explanation, but increased knowledge of the milliped faunas of China, Japan, Siberia, and northwestern North America may indicate past connections, although such evidence may no longer be found except in fossil forms.

Separation of the Cambalopsidae from the older Cambalidae has been made principally on the basis of the species in the former group having an entire or undivided mentum, while the latter group is characterized by species in which the mentum is transversely di-

vided. Whether this difference and several less important and less constant features justify the maintenance of the two families is hardly to be determined from the American material, and for the present the division may be recognized and used without prejudice to simplify classification.

Attems[2] has tentatively, and apparently mistakenly, transferred several American genera of Cambalidae to the Cambalopsidae, although in no instance does the original description give justification for such a course; in fact, the remarks pertaining to the mentum in these genera usually leave no doubt as to its divided structure and would prohibit removal to the Cambalopsidae.

ORDINAL POSITION OF THE CAMBALIDAE AND CAMBALOPSIDAE

Comparing the Cambalidae and Cambalopsidae with the tropical orders of cylindrical millipeds that have closed segments, the Anocheta and Diplocheta, we find an association with the latter in the absence of legs on segment 4; the presence of two pairs of legs on segment 5; and the structure of the mouth parts and gonopods. Also the segments of these two families are like those of the Diplocheta in being divided by a transverse constriction into anterior and posterior subsegments, while in the Anocheta the segments are divided into three belts by two transverse sutures, which often may be seen distinctly, although sometimes scarcely perceptible. The pleural sutures of the Anocheta do not appear in the Cambalidae or Cambalopsidae, except that pleural elements may be indicated by oblique ridges that cross the posterior subsegment from the pedigerous lamina to the posterior margin. Hence the Cambalidae and Cambalopsidae have been placed in the Diplocheta as a suborder, the Cambaloidea, equivalent to the Spirostreptoidea, which is a very large tropical group.

CHARACTERS OF THE CAMBALOIDEA OF THE UNITED STATES

As has been stated, the most significant difference between the Cambalidae and the Cambalopsidae is whether the mentum is entire or is transversely divided, but inasmuch as the genera of these two families may not be separated readily by other contrasting features it is proposed to examine some of the outstanding characters of the American members of the suborder without regard to family alignment.

The structural characters of the Cambaloidea of the United States are very diverse, and only a few of them are common to all the

[2] Kükenthal's Handbuch der Zoologie, vol. 4, p. 207, 1926.

genera. The other characters are scattered among the genera in a quite indiscriminate manner and do not appear to be associated in regular groups to any great degree. This condition might be observed if only a few of a large number of genera were available for examination, for with additional genera the natural groups might be more clearly shown, as in the reconstruction of a broken prehistoric pot, where many fragments are necessary before a correct conception of the shape and design of the pot may be had. Hence, if a few more genera of this suborder are discovered, it is quite probable that relationships will be better understood, and natural groupings made possible.

With one exception the members of the Cambaloidea are slender creatures, 15 to 20 times as long as broad, but the genus *Choctella* is unique, with its stout body only 10 times as long as broad, quite like *Spirobolus*. In most of the genera a few segments immediately behind segment 1 are constricted and definitely necklike, and this condition is carried to its greatest extreme in *Endere*, in striking contrast with *Platydere*, *Nannolene*, and *Choctella*, which have no noteworthy constriction. Five genera have strong dorsal crests on all but a few segments at each end of the body; three genera have a broad, indefinite swelling on each side of the middle and another at the pore; and in the remaining four genera the segments are uniformly smooth. In *Nannolene* and *Choctella* the pores begin on segment 6 instead of segment 5 as in the other genera, and in *Choctella* the pores are said to be "in front of the transverse suture of the somite." This would locate them in the anterior subsegment and furnish another unique condition for this genus, if it has not been misstated.

Five of the genera are without eyes, while in seven genera eyes are present and composed of from 4 to 40 ocelli, but the presence or lack of eyes is not associated with other characters, such as dorsal crests or swellings, or secondary sexual characters. The antennae of all genera are clavate or subclavate, with the second or third joint usually longest and joint 5 the broadest, although joints 4 and 6 sometimes are its equal. The clypeus has a row of four to six setiferous punctures, except in *Tridere*, where the punctures are much more numerous and scattered over the surface without definite arrangement. The labrum of all genera has three distinct teeth, and the base is crossed by a series of 14 to 16 setae, except in *Tridere*, where there are 20 to 24. The mandibulary stipes are recessed for the reception of the antennae in *Odachurus*, *Pharodere*, and *Endere;* in the other genera they are flat or definitely convex.

The last segment is without crests or other surface modifications in all genera except *Tridere*, which has a definite dorsal ridge produced backward behind the valves into a rather blunt, decurved

mucro. In most of the genera there are two setae at the apex of the segment, but in *Platydere* and *Leiodere*, at least, the number is increased to four, six, or eight setae. No specimens of *Paiteya* or *Choctella* have been examined, and in the single specimen of *Endere* all setae have been lost.

In all genera the anal valves are without thickened margins, are evenly inflated, meet at a reentrant angle, and each has two setae near the opening. The preanal scale usually is nearly three times as broad as long, and each lateral angle is covered by a small process from beneath the margin of the last segment.

The first pair of male legs of *Paiteya*, *Nannolene*, and *Cambala* are reduced in size and 6-jointed, and the two latter genera lack a claw on the outer joint; instead this joint is short and rounded at tip in *Nannolene*, while in *Cambala* the inner side is deeply excavated from near the base to the apex. In the other genera of which males are known the first male legs are normal as to structure but frequently reduced in size.

The males of *Nannolene*, *Tridere*, *Pharodere*, and *Cambala* have lobes of various types on some of the joints of other legs in front of the gonopods, but in the other genera of which males were examined none of the pregenital legs are lobed.

From the foregoing brief delineation it is seen how inconsistent are the characters among the genera, and the following key to the genera of the family Cambalidae was prepared without attempting a natural arrangement. Diagnostic characters for the recognition of the genera of the family Cambalopsidae are given on page 57.

Family CAMBALIDAE

KEY TO THE GENERA OF CAMBALIDAE IN THE UNITED STATES

I. EYES PRESENT.

1. Body stout, as in *Spirobolus*---------- **Choctella Chamberlin**
 Body slender, as in *Iulus*---------- 2
2. Last segment projecting beyond anal valves in a distinct mucro; clypeal setae scattered---------- **Tridere, new genus**
 Last segment not mucronate; clypeal setae in a transverse row-- 3
3. Repugnatorial pores beginning on segment 6------ **Nannolene Bollman**
 Repugnatorial pores beginning on segment 5---------- 4
4. Dorsum with 2 indefinite crests between poriferous prominences---------- **Titsona Chamberlin**
 Dorsum with 4 distinct crests between poriferous carinae------ 5
5. Eyes with 4 to 8 ocelli in a single series; first pair of male legs clawless---------- **Cambala Gray**
 Eyes with 9 or 10 ocelli in 2 or 3 series; first pair of male legs with claws---------- **Paiteya Chamberlin**

II. EYES LACKING.

1. Repugnatorial pores beginning on segment 6; dorsum of segments with a weak longitudinal depression on each side, leaving mesial portion a little elevated---- **Buwatia Chamberlin**

Repugnatorial pores beginning on segment 5; dorsum of segments without longitudinal depressions or a median elevation---------- 2

2. Anterior segments not strongly constricted; dorsum without crests---------- **Platydere, new genus**

Anterior segments with sides converging backward, forming a pronounced neck; dorsum with definite crests---------- 3

3. Segment 1 with anterior corners flaring outward away from sides of body; lateral carinae and median dorsal crests produced beyond posterior margins of several caudal segments---------- **Odachurus, new genus**

Segment 1 with anterior corners not flaring away from body; lateral carinae and dorsal crests not produced beyond posterior margin, even on caudal segments.

Pharodere, new genus

TRIDERE, new genus[3]

Type.—Tridere chelopa, new species, from southern California.

Diagnosis.—The strongly mucronate last segment is the most outstanding character, since in no other species in this country does the last segment definitely exceed the anal valves. Also the many scattered setae of the clypeus are unique.

Description.—Body cylindrical, slender, about 16 times as long as broad; head concealed beneath the enlarged first segment; segments 2 to 4 constricted, necklike; last segment mucronate.

Head with the vertex sulcate beneath the first segment, the exposed surface smooth and shining. Clypeus smooth above, with numerous scattered setiferous punctations below. Labrum tridentate and with a transverse row of 20 to 24 fine setae. Mandibulary stipes concealed by the first segment, not recessed to accommodate the antennae. Eyes poorly developed and partially covered by the first segment. Antennae (fig. 10, *a*) inserted in widely separated, deep sockets at the sides of the head, each socket bordered by a raised rim on the upper side and by a projecting lateral corner near the eye; antennae moderately clavate; joints 5 and 6 distinctly thicker than the others; joints 2 and 6 of nearly equal length, 3 and 5 somewhat shorter, but longer than joint 4; joint 7 distinctly projecting and with four olfactory cones. Gnathochilarium as shown in figure 10, *b*.

First segment large, concealing much of the head from above, longer than the next three segments together and much broader, with

[3] The description and remarks pertaining to *Tridere chelopa* were prepared jointly by Dr. O. F. Cook and H. F. Loomis.

lateral expansions carried below the head and mouth parts and much below the ventral line of the adjacent segments; anterior margin straight to below the eyes, then carried forward and downward in a broad, even curve to the rounded posterior corner, the curved margin bordered by a fine raised rim; median surface smooth and shining, lateral surface slightly granular.

Segments 2, 3, and 4 narrowing caudad; segments 2 and 3 smooth above, finely striate low on the sides; segment 4 longer than 2 or 3, with dorsal crests of smaller size but in the same position as those on the ensuing segments, and with a small lateral tubercle in the position of the poriferous carinae.

Succeeding segments gradually broadening, the anterior subsegments considerably exposed, densely and minutely reticulated, the posterior portion constricted and coarsely and regularly fluted in front of the transverse suture; flutings on the lower half of the body usually corresponding to the crests of the posterior subsegment, but the dorsal flutings somewhat more numerous than the crests. Posterior subsegments with about 12 crests between the poriferous carinae; beginning at the middle of the dorsum there is a small crest, then a distinctly larger one, then 3 to 6 smaller crests, which are sometimes quite variable in size and length but are more prominent near the middle of the segment and abruptly lower and narrower behind; the large submedian crests often thickened in front, especially at the anterior end of the body. Lateral carinae with a very large poriferous prominence in front, the carina abruptly interrupted behind it but again raised into a large conic tubercle at the posterior margin. Pores beginning on segment 5 and ending on the antepenultimate segment, opening outward from the smooth oval surface of the pore prominence. Sides below pores with 10 to 12 distinct crests separated by striations; a prominent oblique crest near the legs surrounding a slightly depressed area around the basal joints of the legs.

Posterior segments narrowed gradually, with dorsal and lateral crests reduced; penultimate segment very short, with sculpturing reduced and pores lacking.

Last segment rather long, with an elongate median thickening or ridge continued as a definite mucro beyond the anal valves, surface otherwise smooth.

Anal valves facing obliquely downward, very prominent and inflated, the margins meeting in a deep groove, surface smooth and shining. Preanal scale short and very broad, the posterior margin nearly straight across, somewhat thickened and prominent, with two minute submedian setiferous punctations.

Legs rather long and slender in both sexes, sparsely hirsute; basal joint longer than broad; joint 2 very short; joints 3, 4, and 7 long, subequal; joint 5 slightly shorter; joint 6 still shorter. Pedigerous laminae minutely reticulated, not striate.

Gonopods quite similar in appearance to those in *Cambala*, indicating rather close relationship with that genus.

Segment 6 of the male with the ventral posterior margin behind each leg expanded backward and inward over the gonopods, form-

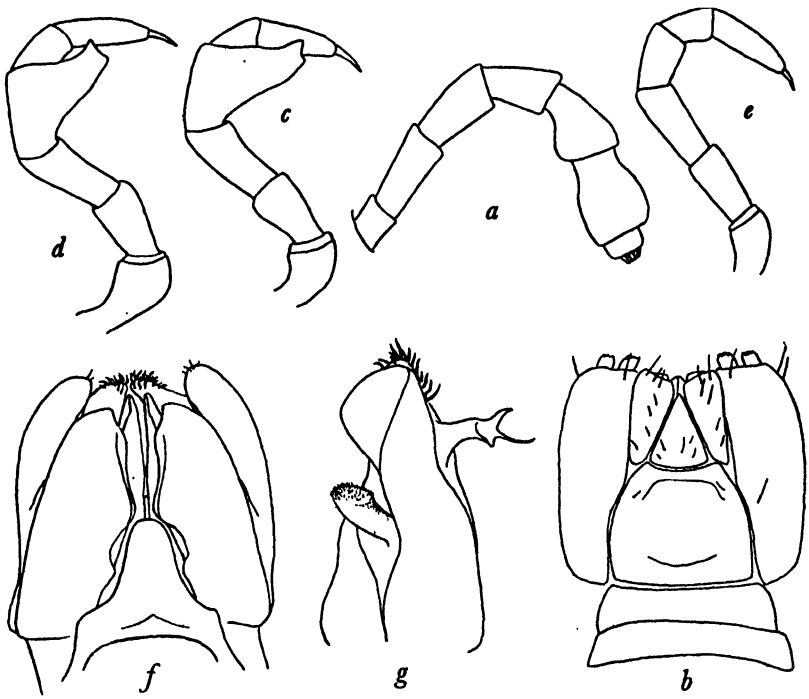


FIGURE 10.—*Tridere chelopa*, new species: *a*, Antenna; *b*, gnathochilarium; *c*, fourth leg of male, posterior view; *d*, seventh leg of male, posterior view; *e*, seventh leg of female; *f*, gonopods of male, anterior view; *g*, posterior gonopods of male, outer lateral view.

ing two flaplike pieces whose mesial margins lap well beyond each other instead of being in contact along the middle line of the body. In segment 7 the opening through which the gonopods are thrust is broadly rounded behind, the margin raised and thickened, and the median ventral suture is open.

Males with the first three pair of legs somewhat reduced in size; legs 4 to 7 inclusive with joint 5 expanded on the inner-posterior side into a large truncated lobe projecting obliquely distad to near the middle of the last joint (fig. 10, *c*, *d*). Leg 7 of female shown in figure 10, *e*.

TRIDERE CHELOPA, new species

FIGURE 10; PLATE 2, FIGURES 6, 7

Several specimens were collected beside the road from San Diego to El Centro, Calif., about 2 miles above Mountain Springs, on the eastern desert slope of the mountains, December 10, 1922, by Dr. O. F. Cook. The animals were found lying extended under stones on a hillside of decomposing granite rock. Their movements were slow and when first disturbed formed a close double coil. The type is a male, U.S.N.M. no. 1304.

After the original collection was made, the type locality was revisited on several occasions, but no further specimens were found. From the dryness of the locality at that time it seemed a very unlikely place for humus inhabitants, but similar places are known in the desert regions of the Southwest where millipeds and other humus animals follow the soil moisture below ground in times of drought but return to near the surface in seasons when moisture conditions improve.

Description.—Length, 30–40 mm; width, 1.8–2.6 mm. Number of segments, 52 to 58.

Living animals mostly light colored, rather dull pinkish or purplish; head and anterior segments much paler; antennae and legs also pale.

Eyes composed of 10 to 15 rather small ocelli in two rows, forming a transverse, sharply wedge-shaped group, partly hidden beneath the first segment.

First segment with dorsal surface smooth, the lateral surfaces with tiny scattered granules and a few short, fine, striations directed obliquely downward and forward from the posterior margin above the back corner. Last segment appearing smooth, but slight magnification shows a few faint striae and granules; apex of the mucro bearing two setae. Other segments as described under the genus.

Gonopods as shown in figure 10, *f* and *g*.

Genus CAMBALA Gray

Head with eyes in a single series; antennae moderately stout.

First segment about as long as the next two segments together, not expanded on the sides.

Body rather slender, the anterior segments not noticeably constricted to form a neck behind the head and first segment. One to three segments at each end of the body smooth above, the others with four strong crests between the large poriferous carinae. Pores beginning on segment 5.

Last segment not projecting beyond the anal valves.

First pair of male legs 6-jointed and without a claw at tip. The fifth, sixth, and seventh male legs have a large lobe on the ventral side of the fourth joint and sometimes one on the fifth joint also.

KEY TO THE SPECIES OF CAMBALA

1. Body small and slender, not exceeding 20 mm in length and 0.8 mm in width; dorsal crests beginning on segment 4 and ending on antepenultimate segment **texana, new species**
 Body larger and stouter; crests beginning on segment 2 and ending on penultimate segment 2
2. Body of intermediate size, 25 to 38 mm long and 1.2 to 2 mm broad; color light yellowish brown **minor Bollman**
 Body considerably larger, 44 mm or more in length; color definitely darker brown 3
3. Body 18 or 19 times as long as broad; segment 1 with posterior angles produced backward; poriferous keels very strongly developed **annulata (Say)**
 Body decidedly stouter, 14 to 15 times as long as broad; segment 1 with posterior angles less produced backward; poriferous keels much less prominent; gonopods differing in a number of particulars, as shown in the drawings **cristula, new species**

CAMBALA ANNULATA (Say)

FIGURE 11

Julus annulatus SAY, Journ. Acad. Nat. Sci. Philadelphia, vol. 2, p. 103, 1821.
Spirobolus annulatus (Say) WOOD, Trans. Amer. Philos. Soc., vol. 13, p. 212, 1865.
Cambala annulata (Say) COPE, Proc. Amer. Philos. Soc., vol. 11, p. 181, 1869.

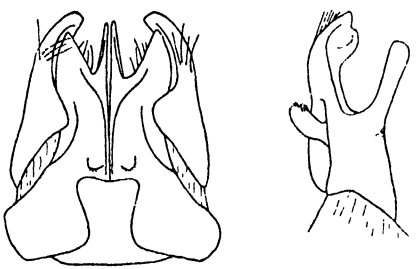
Specimens of this species were collected between Roan Mountain and Elizabethton, Tenn., in October 1928 and between Marshall and Hot Springs, N. C., in October 1929 by O. F. Cook. The species has been reported from nearly all the Southeastern States and from Kentucky, but it now seems likely that at least two species, *annulata* and *cristula*, were confused, and the value of these older records must now be shared by these two species, though it is usually not definitely certain to which form specific records apply. The specimens here described and illustrated are believed to represent the typical *annulata* of Say, inasmuch as they are the only ones studied that have the poriferous carinae distinctly "pyriform" as stated in the original description. Bollman reported this species from Indiana and Arkansas, but later he designated the specimens as a subspecies of *annulata* on account of their smaller size and lighter color. It is proposed herein to elevate this subspecies to full specific rank.

The following description has been prepared from the Tennessee and North Carolina specimens to facilitate comparison with the other species of the genus:

Description.—Large but moderately slender animals; 45 to 58 mm long and 2.5 to 3.1 mm broad. The specimens examined had 56 to 65 segments. Some of Bollman's specimens had as few as 50 segments.

Head having eyes composed of four to eight ocelli in a single series paralleling and almost covered by the first segment. Antennae moderately stout; joint 2 the longest; joint 6 the broadest. Clypeus with six setiferous punctures; labrum with 16 smaller ones. Mandibulary stipes with the lower half slightly depressed for the reception of the antennae. Gnathochilarium with mentum in two distinct parts, the basal one broader at its apex than the bottom of the upper part.

First segment as long as the three succeeding segments combined and broader than any of the anterior segments; surface smooth; the lateral margin distinctly rimmed; posterior angles slightly produced backward.



a *b*

FIGURE 11.—*Cambala annulata* (Say): *a*, Anterior gonopods, anterior view; *b*, posterior gonopods, lateral view.

Behind segment 1 the ensuing segments are considerably narrowed and then increase gradually in breadth to near the middle of the body. Segments 2 and 3 have small distinct crests in the same positions as those on the ensuing segments, the lateral carinae are no longer than the dorsal crests, but on segment 4 the lateral carinae are slightly more prominent than the dorsal crests. Segment 2 has a high, conspicuous ridge on each side just behind the posterior corner of segment 1.

On the succeeding segments there are four very prominent crests between the poriferous carinae, intervals between the crests equal but narrower than the interval between the outer dorsal crest and the adjacent poriferous carina, these latter more prominent than the dorsal crests, the anterior three-fifths thickened and inflated into an ovate process somewhat oblique to the side of the body with the pore near its posterior third; behind the thickened process the carina is abruptly retracted, forming a short, thin ridge about as high as

the dorsal crests. On the anterior segments the pore swellings are conic and oblique to the sides of the body, while on the caudal segments they are lower, more flattened, and nearly parallel with the body. On the penultimate and antepenultimate segments the lateral carinae are no larger than the dorsal crests, but on the next segment in front the differentiation is evident. Below the poriferous carinae are 12 to 14 crests decreasing in size toward the legs, even the upper ones less conspicuous than the dorsal crests.

Last segment smooth, the apex rounded, not exceeding the valves.

Preanal scale large, about half as long as broad; the tab processes at the lateral angles relatively large and conspicuous.

Gonopods as shown in figure 11, *a* and *b*.

First pair of male legs with the last joint bluntly and obliquely truncated on the inner side halfway to the base, the truncation deeply excavated, claws lacking. Legs 4 to 7 inclusive with the outer joint densely hairy beneath; behind the gonopods to the end of the body the five outer joints also are densely hairy beneath, those at rear somewhat less so than those in front. Female legs less hairy. Legs 5 to 7 of the males with the fourth joint bearing a large, hairy-tipped, conic prominence near the distal end on the under side; the fifth joint of these legs sometimes with a similar but smaller lobe.

Segments 6 and 7 of the males with the margin surrounding the genital opening greatly elevated mesially, equaling the top of the first joint of the adjacent legs.

CAMBALA CRISTULA, new species

FIGURE 12

Many specimens collected at Etowah, Tenn. (type locality), November 1, 1929, and a male and a female collected at Adams Run, S. C., October 11, 1929, by Dr. O. F. Cook. The type is a male, U.S.N.M. no. 1305.

This species is closely related to *annulata* but distinguished from it by the stouter body, a female specimen 44 mm long being 3 mm broad; the much less prominent poriferous keels; the smaller produced posterior angles of segment 1; lateral keel on each side of segment 4 no larger than the four dorsal crests, while in *annulata* there usually is a decided contrast; the presence of a lobe on the ventral surface of the fifth joint of legs 5, 6, and 7 of the males, a condition infrequently observed in *annulata*, but like *annulata*, with a large lobe beneath the fourth joint.

The principal difference, however, is found in the structure of the gonopods (fig. 12, *a* and *b*) as a comparison of the drawings of the two species will show.

Leg 1 of the male is shown in figure 12, *c*.



FIGURE 12.—*Cambala cristula*, new species: *a*, Anterior gonopods, anterior view; *b*, posterior gonopods, lateral view; *c*, first leg of male.

CAMBALA MINOR Bollman

Cambala annulata minor BOLLMAN, Proc. U. S. Nat. Mus., vol. 11, p. 404, 1888.
Cambala annulata (Say) WILLIAMS and HEFNER, Ohio State Univ. Bull. No. 18, vol. 4, p. 123, illus., 1928.

Specimens of *Cambala* from Little Rock, Ark., and various localities in Indiana were designated by Bollman as representing a new subspecies of *C. annulata* because of lighter coloration and smaller size than specimens from the Southeastern States, whence came Say's specimens of *annulata*. Although Bollman's specimens of *minor* have not been examined, it seems probable that they are the same species as the specimens from Ohio that Williams and Hefner described and figured as *C. annulata*. Comparison of their drawing of the gonopods of the Ohio form with drawings of the gonopods of *annulata*, as interpreted in this paper, shows that two species are involved. If we assume that the Ohio form is the same as that which Bollman had from Indiana, it is necessary to give full specific rank to these forms, using the name Bollman proposed for his subspecies.

Specimens of *annulata* reported by Packard from the Kentucky caves were suspected by Bollman of being either his small subspecies *minor*, or a true and unnamed cave form, and this point still remains unsettled.

CAMBALA TEXANA, new species

FIGURE 13

A large number of specimens were collected at Nacogdoches, Tex., in January 1931 by H. C. McNamara and Dr. O. F. Cook. The type is a male, U.S.N.M. no. 1306.

Diagnosis.—The smaller size of the body, more numerous noncrested segments, the granular crests, and the modifications of the gonopods distinguish this species from the other members of the genus.

Description: Length, up to 20 mm; width, to 0.8 mm. Number of segments, 45–51.

Head with four to seven ocelli in a single series. Mentum narrower than in *annulata.* Mandibulary stipe flattened, with a raised rim along the lower margin.

First segment wider than the head, providing a recess on either side into which the antennae may be bent back; lateral margin bordered by a very fine rim; posterior angles not produced.

Segments 1, 2, and 3 smooth and shining, minutely and sparsely granular. Crests beginning abruptly on segment 4, with four broad crests on the dorsum between the scarcely more prominent poriferous keels, which are represented by oval or subelliptical swellings. On the side of the body below the poriferous keels there are 14 or 15 thinner crests. Surface of the dorsal and lateral crests and the poriferous keels finely but distinctly granular. Dorsal crests sometimes evident on the antepenultimate segment but never on the last two segments.

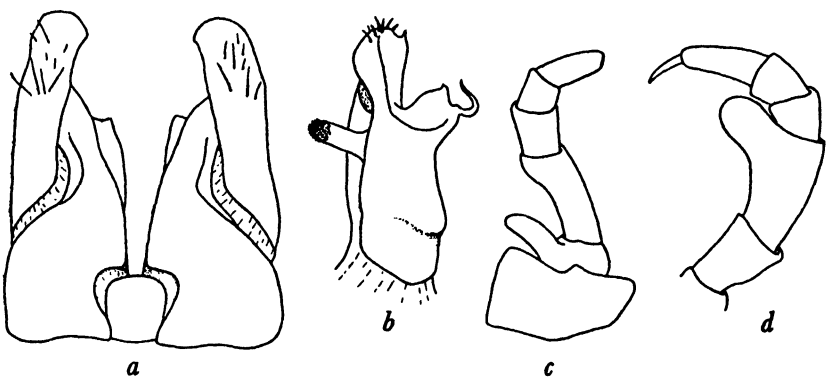


FIGURE 13.—*Cambala texana,* new species: *a,* Anterior gonopods, anterior view; *b,* posterior gonopods, lateral view; *c,* first leg of male; *d,* outer joints of sixth leg of male.

Last segment relatively longer than in *annulata,* the apex more deflexed and the valves, in lateral view, more oblique. Preanal scale transverse, much less rounded than in *annulata.*

Gonopods and first male legs as shown in figure 13, *a–c.*

Legs 5, 6, and 7 of the male with a very large process on the ventral side of the fourth joint near its distal end, its apex extending beyond the end of joint 6 (fig. 13, *d*).

Genus PAITEYA Chamberlin

This genus has some affinity with *Cambala* as shown by the presence of eyes; four dorsal interporiferous crests; first male legs with six joints. The size, however, is much smaller; the eyes are in two

or three rows; the body is "constricted caudad of head, most strongly so over from about fourth to the ninth segments"; the first four and the last three segments are smooth above; the pores are borne "on the enlarged caudal portion of edge of the lateral carina," contrary to the position in *Cambala* and *Tridere*, which have the anterior portion of the carina enlarged and bearing the pore.

PAITEYA ERRANS Chamberlin

Paiteya errans CHAMBERLIN, Ann. Ent. Soc. Amer., vol. 3, p. 258, pl. 43, figs. 4–7, 1910.

This species, which I have not seen, was described without definite locality from southern California. It is 19 mm long, 1.4 mm wide, and has 47–49 segments.

Genus TITSONA Chamberlin

Eyes well developed, five to seven ocelli in a single series. First segment longer than the next three segments together, the sides encircling the sides of the head but well removed, leaving an intervening space into which the antennae may be folded back. Body strongly constricted between segment 1 and segments 5 and 6. First four segments and the last two segments smooth above, the intervening segments with two low, rounded crests near the middle of the dorsum, between the hemispherical pore swellings. In the specific description it is stated that the crests begin on segment 4, but this condition is not shown in the illustration. First male legs reduced in size and 6-jointed, the last joint terminating in a strong claw.

The single species seems more closely related to *Paiteya* than to other known genera.

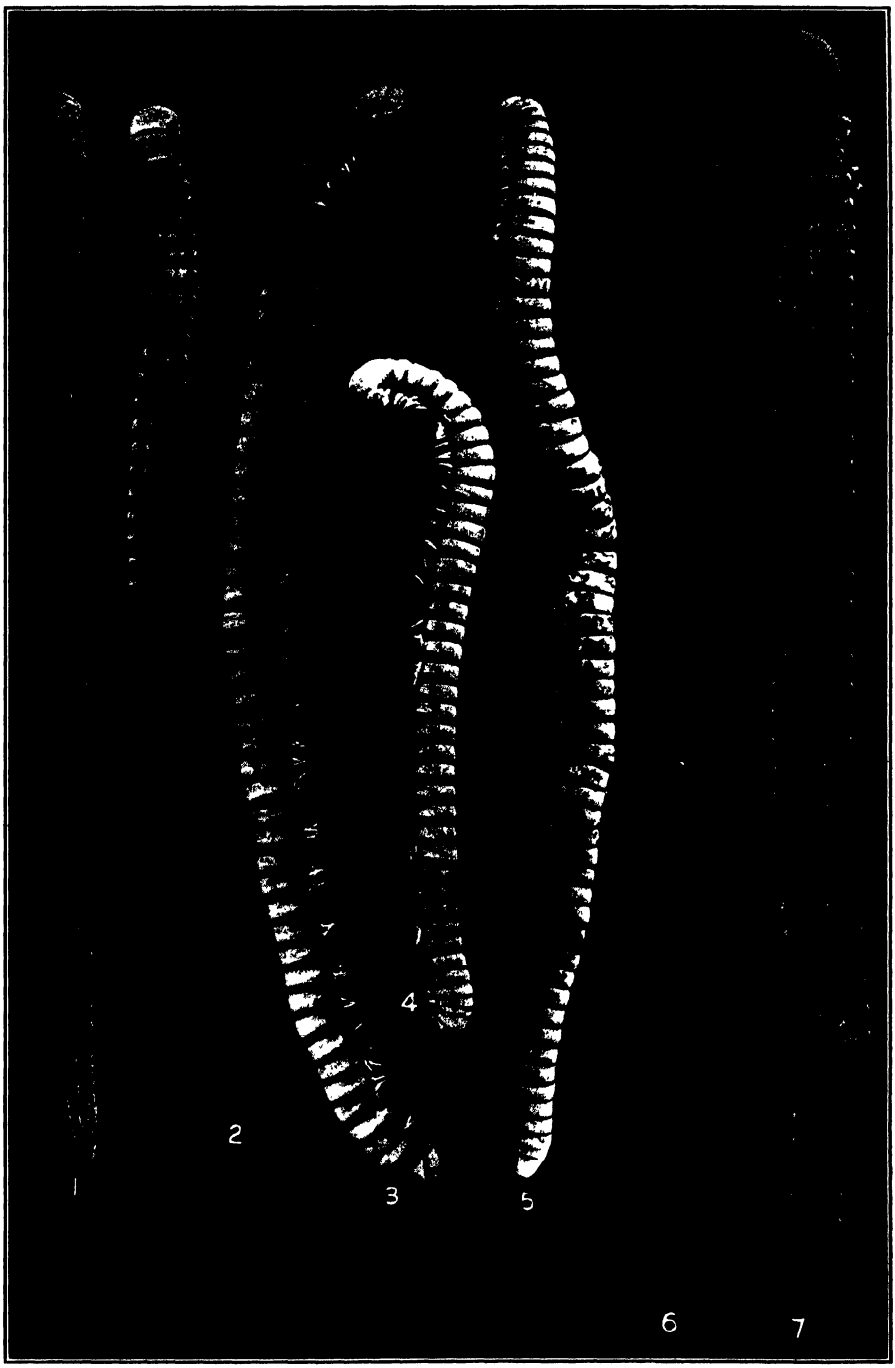
TITSONA SIMA Chamberlin

Titsona sima CHAMBERLIN, Ann. Ent. Soc. Amer., vol. 5, p. 161, pl. 10, figs. 4–6, 1912.

Known only from the original collection of two specimens at Oroville, Calif. The length is 16 mm; width, 1 mm; number of segments, 42.

Genus NANNOLENE Bollman

Body small, slender, *Iulus*-like; smooth above; anterior segments definitely striate on the sides from the feet to near the pores, the striae receding on the other segments. Segments, except the first four and the anal segment, with a broad, deep transverse constriction around the middle, giving the body a submoniliform appearance, the constriction with a series of rounded pits at bottom.



1, *Pharodere radiata*, female, × 7½; 2, *Leiodere dasyura*, male, × 8; 3, *Nannolene violacea*, female, ×8; 4, *Leiodere torreyana*, lateral view of female, × 7½; 5, *L. torreyana*, dorsal view of female; 6, *Tridere chelopa*, lateral view of male, × 5¼; 7, *T. chelopa*, dorsal view of male, × 5¼.

Head with triangular eyes composed of 12 to 26 ocelli in three to five series. Antennae short and stout with joints 2 and 6 subequal. Clypeus with four setiferous punctures. Mandibulary stipes inflated, not recessed for the reception of the antennae. Gnathochilarium with the mentum in two parts.

First segment long, usually equaling or exceeding in length the next two segments together; anterior angles very broadly rounded and not produced forward; lateral margin with a raised rim; lateral surface with one or more longitudinal striae.

Segments 2 to 4 not narrowed to form a necklike constriction.

Pores beginning on segment 6; each pore surrounded by a flattened rim.

Last segment as long as the two preceding segments together, the apex broadly rounded and with two setae.

Segment 6 of the males with the pleurae overlapping at the middle and produced caudad, partially covering the opening for the gonopods. Anterior margin of segment 7 distinctly raised and thickened around the opening for the gonopods.

First pair of male legs reduced in size, 6-jointed, the apical joint short, rounded-conic, and without a claw.

Sixth and seventh male legs with a hollow conic process on the interior face of the penultimate joint.

KEY TO THE SPECIES OF NANNOLENE IN THE UNITED STATES

1. Size large, 25 mm in length; eyes composed of about 26 ocelli. **burkei** (Bollman)
 Size not exceeding 20 mm; eyes composed of not more than 22 ocelli--- 2
2. Body almost white except for a few segments at either end. **minor**, new species
 Body darker, more uniformly pigmented--- 3
3. Length to 20 mm; number of segments to 51; first segment longer than next two together--- **violacea**, new species
 Size somewhat smaller, number of segments less; first segment shorter than next two segments together---**uta** (Chamberlin)

NANNOLENE BURKEI (Bollman)

Iulus burkei BOLLMAN, Amer. Nat., vol. 21, p. 82, 1887.
Nannolene burkei BOLLMAN, Ann. New York Acad. Sci., vol. 4, p. 40, 1887.

This species was described from two mature female and two immature male specimens from Ukiah, Calif., and no subsequent localities have been reported. Chamberlin does not state the source of the material from which his drawings were made.[4]

This species is distinguished from our others by the greater number of ocelli—26 in five series; the larger size of the body—25 mm

[4] Proc. U. S. Nat. Mus., vol. 61, art. 10, pl. 1, figs. 4–10, 1922.

long and 1 mm broad; and the shape of the male genitalia, as shown by Chamberlin's drawing in which the anterior plate and the lateral plate on each side are united instead of two distinct structures as in the other species.

NANNOLENE MINOR, new species

FIGURE 14

Numerous specimens collected near Bakersfield, Calif., December 12, 1927, by Dr. O. F. Cook. The type is a male, U.S.N.M. no. 1307.

Diagnosis.—This species is closely related to *N. burkei* and *N. violacea.* It differs from both species in the smaller body, usually fewer segments, fewer ocelli, and in the structure of the gonopods.

Description.—Body slender, 18 to 20 times as long as broad, moderately moniliform; length, 11 to 16 mm; number of segments, 40 to 47; neck constriction slight, segments 2 to 4 but little narrower than the adjacent segments.

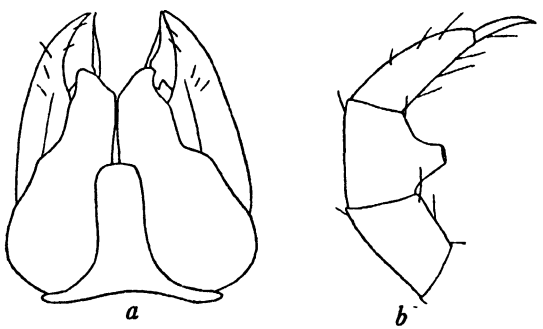


FIGURE 14.—*Nannolene minor,* new species: *a,* Anterior gonopods, anterior view; *b,* three outer joints of leg 7 of male.

Color in life whitish, the extremities of the body darker and very faintly maculate with light violet-brown without definite arrangement. Each side of body with a series of small, dark spots, the repugnatorial glands, showing through the segments.

Head not bent under the first segment; surface distinctly reticulate; vertex with a pronounced median impressed line, from the anterior end of which, on each side, a finer impressed line curves forward and laterad, reaching the upper corner of the eye. Ocelli 12 to 18 in three or four series, forming a subtriangular patch close to the margin of segment 1. Antennal sockets distant from the front corners of segment 1. Clypeus with two large setae on each side. Labrum with three teeth; the base crossed by a series of 16 setae, those on the sides longer than at the middle. Mandibulary stipes flush with the sides of the head and the first segment, strongly inflated and with a distinct raised margin and a prominent lower corner; surface coarsely reticulated.

First segment as long as the next two and a half segments together; surface finely reticulated; anterior corners inconspicuous, very broadly rounded but not produced forward; anterior margin straight; lateral margin very weakly rounded, descending obliquely to the posterior corner and with a distinct raised rim; posterior corner sharper than a right angle and clasping the side of the body; lateral striations distinct, four to five, the middle longest, crossing from behind to near the anterior margin.

Segments 2, 3, and 4, viewed from the side, are almost flat along the dorsum, much less convex than the ensuing segments, which have the two divisions strongly separated by a transverse constriction. Lateral striations increasing in height to segment 5, but not reaching the line of the pores; thereafter receding gradually, and on the caudal segments almost entirely confined to the ventral surfaces.

Midbody segments with transverse constrictions very broad, rather shallow, and containing a row of large, irregularly rounded, shallow pits, frequently separated from one another by more than half their width; anterior and posterior subsegments convex, the posterior division more strongly so and with fine, short, impressed longitudinal lines in addition to the tiny reticulations that cover the surface; anterior subsegments more coarsely reticulated. Pores located well behind the transverse constriction near the anterior third of the subsegment; each pore surrounded by a conspicuous, broad, flattened rim.

Last segment as long as the two preceding segments together; margin evenly rounded except for a short distance at the apex, between the two setae, where it is more truncate.

Anal valves projecting behind the last segment; strongly inflated, with margins meeting in a broad deep groove.

Preanal scale a third as long as broad; transversely elliptic; the hind margin more acutely rounded and with a seta on each side of the middle; at each lateral angle a tiny, narrowly elliptic process bearing a seta projects out from under the margin of the last segment.

Male genitalia nearly concealed, the prominent overlapping pleurae of segment 6 produced backward beyond the line of the margin elsewhere and partly covering the opening in segment 7, which is biarcuate behind and has the margin strongly raised and subrevolute.

Male genitalia in two distinct parts. Anterior gonopods (fig. 14, *a*) differing from those of *N. burkei*, as figured by Chamberlin,[5] by having the ventral plate transverse at base instead of strongly produced downward from the lateral angles; each anterior plate with the apex produced into a short, slightly outward turned lobe,

[5] Proc. U. S. Nat. Mus., vol. 61, art. 10, pl. 1, figs. 4–10, 1922.

instead of being squarely truncate (the anterior plates in Chamberlin's drawing appear united to the lateral plates); lateral plates more acute at apex, with the upper half of the posterior margin produced inward and forward. Posterior gonopods erect, rather slender, hollowed in front to near the rounded apex from which numerous papillate hairs curve backward; anterior ectal margin with a triangular process directed forward.

Penultimate joint of male legs 6 and 7 with a conical prominence on the inner side larger than in *N. burkei* and with the apex squarely truncate and hollow (fig. 14, *b*)

First male legs similar to those of *burkei* as shown in Chamberlin's drawings previously referred to.

Legs behind the genitalia with a long cavity in the ventral surface of joint 3.

NANNOLENE VIOLACEA, new species

FIGURE 15; PLATE 2, FIGURE 3

Collected by Dr. O. F. Cook in the following California localities: Many specimens of both sexes south of Atascadero, the type locality, January 1, 1928; one female from Tejon Pass, December 14, 1927; one male and many females from Grapevine, below Fort Tejon, February 28, 1929. Two males, lacking one molt of maturity, from Medford, Oreg., June 15, 1937, and a similar male from Chico, Calif., June 24, 1937, collected by L. D. Christenson and L. S. Jones and sent to me by the U. S. Bureau of Entomology and Plant Quarantine, have been identified as this species. The type is a male, U.S.N.M. no. 1308.

Description.—This species is very closely related to *N. minor*, from which it differs most evidently in the following particulars: Body of the same proportion, but sometimes reaching a length of 20 mm; segments as many as 51; ocelli in fully developed specimens in four series containing 18 to 22 ocelli.

Body distinctly pigmented with violaceous-brown, maculate with colorless spots. Head with vertex colored and maculate with many small light spots, which sometimes are confluent; in front of this area the color is unevenly peppered over the surface, becoming lighter toward the front margin of the head; a very large, transverse, oval, colorless area on each side between the antennae; above and slightly mesad of these are two smaller rounded areas. First segment with a very large oval area mottled with light blotches on each side of the fine dark median line; these areas bounded by a solid band of color, broad at the middle of both the front and hind margin and still broader near the hind angles; outside of this band the margins of the segment are colorless and semitransparent, the anterior colorless margin much broader than that behind. Other segments with the

anterior subsegment and the front half of the posterior subsegment colored and finally maculate with tiny light spots and with a series of much larger light spots across the middle of the anterior subsegment and another less distinct series in the constriction; two areas maculate with colorless spots on the anterior subsegments near the legs; the caudal half of the posterior subsegment uncolored and transparent. The series of brown spots on each side of the body is not conspicuous as in the other species, the spots small and partly masked by the other coloring. Last segment with the colored surface very finely peppered with tiny light spots, except immediately behind and under the penultimate segment, where there are numerous large light spots; posterior margin colorless. Valves and preanal scale slightly colored.

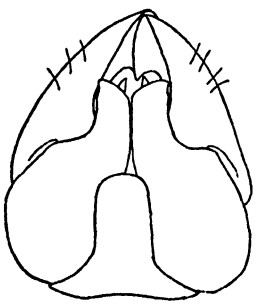


FIGURE 15.—*Nannolene violacea*, new species: Anterior gonopod, anterior view.

Genitalia (fig. 15) showing close relationship to *N. minor*, but the ventral plate shorter and broader; the anterior plates less produced, more acute at tip, more abruptly expanded and wider at base; lateral plates with the rolled margins of the apical lobes less conspicuous from in front, and the lobes of slightly different shape. Posterior gonopods not observed.

NANNOLENE UTA (Chamberlin)

Nemasoma uta CHAMBERLIN, Ann. Ent Soc. Amer., vol. 5, p. 162, 1912.
Nannole uta CHAMBERLIN, Pan-Pac. Ent., vol. 2, no. 2, p. 61, 1925.

This species was described as a member of the genus *Nemasoma* from a single female specimen found in Little Willow Canyon, Utah, and although the species was again reported from the same locality it was not stated that additional specimens were involved, and it is probable that its inclusion in the paper was for the purpose of relocating it in the genus *Nannolene*, the designation "*Nannole*," which appeared in this second report, being a typographical error, I have been informed by Prof. Chamberlin.

Because of the variations of size, color pattern, numbers of segments, and ocelli, within the species of this genus, the value of these characters in single specimens is reduced, but the short first segment in *uta* probably is a constant character and should be sufficient to distinguish this species from the other members of the genus in our fauna.

Genus BUWATIA Chamberlin

Head without eyes; antennae subclavate, resting in an excavation extending from the socket to the lower margin of the first segment

First segment large, embracing the head; with a fine transverse sulcus subparallel to the anterior margin and some distance from it; a second, submedian, sulcus present. Ensuing segments constricted to segment 6. Segments smooth, the dorsum a little depressed, with a weak longitudinal depression each side of middle, leaving mesial portion a little elevated. Since it was stated that the genus is closely related to *Nannolene*, being distinguished from it by the lack of eyes, it is assumed that the pores begin on segment 6. Last segment with a depression in front of the apex. Claws long and slender.

This genus may be intermediate in position between *Nannolene* and *Platydere*, because it is thought that pores begin on segment 6 as in the former genus, and it is without eyes as in the latter genus. From both it differs in having a necklike constriction behind the head, and the dorsum slightly depressed on either side of a slight median elevation. There is but one species.

BUWATIA MONTEREA Chamberlin

Buwatia monterea CHAMBERLIN, Ann. Ent. Soc. Amer., vol. 5, p. 159, pl. 10, fig. 7, 1912.

Described from a single specimen, apparently a female, found at Pacific Grove, Calif. The species has not since been reported.

PLATYDERE, new genus

Type.—*Platydere caeca*, new species, from southern California.

Diagnosis.—Closely related to *Nannolene*, as shown by the smooth segments, the inconspicuous constriction of the neck segments, the row of deep pits in the transverse constriction of the segments, and by the rimmed pores. It differs, however, in being without eyes, in having the first pores on segment 5, and in having four or possibly six apical setae on the last segment, the lateral margin of which is deeply emarginate in front of the processes covering the lateral angles of the scale.

Description.—Body stout, about 16 times as long as broad; with scarcely any constriction of segments 2 to 4 to form a neck; surface appearing very smooth and strongly shining.

Head without a median sulcus or transverse impressed lines as in *Nannolene;* eyes lacking. Antennae inserted on the dorsolateral surface; moderately clavate; joint 2 shorter than joint 3, which is slightly longer than any of the others; joints 4 and 6 subequal, shorter than joint 5, which is the widest joint. Clypeus with sides almost continuous with the labrum but with middle abruptly raised

above it; two setae on each side. Labrum tridentate, with a basal series of setae. Gnathochilarium much as in *Nannolene* but proportionately wider and with upper section of the mentum relatively shorter in relation to the lower section. Mandibulary stipes noticeably convex, not recessed to receive the antennae; with a raised margin.

First segment shorter than the next three segments together; anterior corners more prominent than in *Nannolene* and with the lateral margin much less oblique, with a raised rim reaching around the anterior corner, the sides without striae; posterior corners strongly curved under and clasping the sides of the second segment.

Segments 2, 3, and 4 almost as broad as segments 1 and 5. Segment 4 with the anterior and posterior divisions distinct and separated by a shallow constriction lacking the pits of the succeeding segments; posterior division more convex than the anterior division or than segment 2 or 3. Segment 5 slightly larger than segment 4; the large repugnatorial pore on the anterior fourth of the subsegment surrounded by a broad flattened rim. On segments farther back the pore is located just in front of the middle of the subsegment.

Anterior subsegments near the middle of the body but little less convex than the posterior subsegments and separated from them by a broad and shallow constriction, in the bottom of which is a row of closely placed deep oval pits; posterior subsegments evenly convex from the constriction to the back margin; with many tiny longitudinal impressed lines seldom connected as are those on the segments of *Nannolene*. Lateral striations few and wide-spaced, highest on segments 5 and 6, where they reach halfway to the pores; on the caudal segments they are almost entirely confined to the ventral surfaces. Segments near caudal end of body becoming less convex. Penultimate segment nearly as long as the antepenultimate, almost flat.

Last segment relatively short, not as long as the two preceding segments together; apex subangularly rounded but less produced backward than in *Nannolene;* with three setae on one side of the middle and two on the other side in the type specimen, indicating six setae normally; an additional seta near the middle of the hind margin on each side; margin immediately in front of the large tablike processes very deeply emarginate, exposing much of them.

Valves moderately inflated; margins meeting in a deep groove; each valve with the usual two setae near the opening. Scale relatively long; posterior margin more rounded than the anterior margin and with a pair of widely separated setae.

PLATYDERE CAECA, new species

A single mature male specimen collected with specimens of *Leiodere dasyura* at Tajiguas, Calif., January 1, 1928, by Dr. O. F. Cook. Type: U.S.N.M. no. 1309.

Description.—Body rather stout, 16 mm long and 1 mm wide. Number of segments, 44. Color almost white, with the repugnatorial glands showing through the sides of the body as a series of small orange spots, which turned almost black after the specimen had been stored in alcohol.

Head smooth and shining; surface of the vertex with tiny, very faint, impressed reticulations visible only by cross lighting under moderate magnification; labrum with a series of 14 setae at base.

Segment 1 as long as the next two and a half segments together; the posterior corners strongly curved under and clasping the lateroventral surface of segment 2, not produced backward; entire posterior margin straight; as seen from above, the sides of the segment are almost parallel, being slightly rounded from front to back, the segment widest at the middle or a little way in front of it.

Segments 2, 3, and 4 scarcely constricted, the posterior margin of segment 4 being over seven-eighths the width of segment 1 at its widest part. Segments 2 and 3 not longitudinally convex, flat, when viewed from the side.

Near the middle of the body the exposed portion of the anterior subsegments is very smooth and shining and has a few long, slightly wavy, impressed, longitudinal lines; the covered part of the subsegment has coarse reticulations showing through the transparent posterior subsegment of the preceding segment; posterior subsegments scarcely higher than the anterior subsegments.

Preanal scale about three times as broad as long, the posterior margin rounded.

Genus CHOCTELLA Chamberlin

Body large and stout, only about 10 times as long as broad; dorsal surface smooth; lateral surface strongly striate from the feet to the repugnatorial pores. Eyes composed of many ocelli arranged in five or six rows. Antennae short and stout. Clypeus with six setiferous punctures. First segment extending forward over the head and partly concealing the antennae; anterior angles broadly rounded and distinctly produced forward; lateral margin with a raised rim. Repugnatorial pores large, beginning on segment 6 as in *Nannolene*, but said to be "in front of and well removed from the transverse suture," a statement that is open to question, as in all the other members of the family that the writer has examined the pore is in the posterior subsegment, definitely behind the constric-

tion. Last segment evenly rounded at apex and exceeded by the anal valves. First pair of male legs reduced in size but otherwise normal. Segment 7 of the males with the margin around the gonopods moderately elevated.

Only one species is known.

CHOCTELLA CUMMINSI Chamberlin

Choctella cumminsi CHAMBERLIN, Psyche, vol. 25, p. 25, 1918.

This species was described from a dozen specimens collected in the Glendale Hills of Tennessee and has not since been reported.

Average length, 50 mm; number of segments, 44 to 48; general color black, the segments apparently with yellowish or reddish markings in front and along the posterior margins. Eyes with 30 to 40 ocelli in five or six series forming a triangular group. Antennae with joints 2 and 3 subequal, longer than the others; joints 5 and 6 broadest. "Coleopods simple, thin plates, each of which is moderately narrowed distad and narrowly rounded at the apex; below apical portion the mesal border of each is bent subcaudad. Phallopods exceeded by the coleopods. Each with distal division narrowly subconical, distally curved mesad, the tip somewhat obliquely truncate."

PHARODERE, new genus

Type.—Pharodere radiata, new species, from southern California.

Diagnosis.—This genus and *Odachurus* are the only eyeless members of the family in this country that have well-defined dorsal crests. *Pharodere* differs from *Odachurus* by lacking the flaring anterior corners of segment 1 and the swollen dorsum near the back margin, but there are prominent lateral striae on this segment; and on the caudal segments neither the lateral carinae nor the dorsal crests project as teeth beyond the back margin, and the crests are higher and more abruptly raised than those of *Odachurus*.

Description.—Body slender, about 20 times as long as broad; segments as many as 64.

Head without eyes. Antennae widely separated, inserted on the dorsolateral surface, moderately clavate, the basal joints slender as compared to the outer joints. Clypeus with three setae on each side. Labrum tridentate, somewhat depressed below the clypeus, and with a basal row of setae. Gnathochilarium as shown in figure 16, *a*. Mandibulary stipes receding beneath the head, the lower half hollowed to receive the antennae.

First segment not quite so long as the next three segments together, widest near the front corners which are broadly rounded, somewhat produced forward, and with the intervening front margin nearly straight; lateral margin with a raised rim, rounded and very obli-

quely descending to the back corner, which is not quite a right angle and clasps the side of the body; lateral surface striate.

Segments 2, 3, and 4 with the sides gradually converging behind, necklike, the posterior margin of segment 4 only three-fourths as wide as segment 1. Segments 2 and 3 flat, not at all convex, dorsum smooth, the sides with striations. Segment 4 with the anterior subdivision somewhat exposed; the posterior subdivision moderately convex and with crests as on the subsequent segments, but less distinct.

Anterior division of the midbody segments moderately convex; crossed behind by a series of channels nearly twice as long as broad and usually with a large, deep, round or oval pit occupying the back half of each channel; channels separated from each other by a thin raised ridge; in front of the channels the surface is coarsely and distinctly honeycomb-reticulated. Posterior subsegments abruptly elevated from the constriction but with the dorsum flat, not at all convex as seen from the side; between the prominent poriferous carinae are six to eight thin and high longitudinal crests crossing the subsegment, the inner pair conspicuously thicker and higher than the others and more widely separated, the smaller crests number two to four on each side with three the rule. Lateral carinae prominent, abruptly elevated from the sides, greatly thickened in front into a broad, oval area with a rather large depression containing the pore; posterior part of the carina thin, ending in a right angled corner above the posterior edge of the segment. Beginning on segment 5 and for several segments thereafter the pores are borne on broad, rounded elevations rather than on a definite carina. Below the poriferous carinae are 12 to 15 longitudinal striations. Penultimate segment with dorsal crests and lateral carinae almost as strong as those on the foregoing segments.

Last segment smooth and shining, the dorsum scarcely convex in lateral view, not quite so long as the two preceding segments together; posterior margin thickened, especially at the apex, which bears two setae and is narrowly rounded and projects a little beyond the valves but not as a conspicuous mucro. Valves little inflated and with margins meeting in a narrow, shallow groove. Preanal scale almost four times as broad as long, the posterior margin nearly straight; tab processes small.

Segment 6 with the margin around the gonopods scarcely raised but the overlapping pleurae are strongly produced backward, nearly covering the gonopods. Segment 7 with the genital opening semicircular, the margin not separately raised.

First and second male legs smaller than ensuing legs, with well-developed claws. Sixth and seventh male legs with a process on the inner side of the penultimate joint somewhat similar to that in the same position in *Nannolene*.

PHARODERE RADIATA, new species

FIGURE 16; PLATE 2, FIGURE 1

Several males and numerous females collected with *Odachurus petasatus* and *Leiodere torreyana* under stones on the cliffs near the sea at Torrey Pines, La Jolla, Calif., November 26, 1925, by Dr. O. F. Cook and H. F. Loomis. The type (U.S.N.M. no. 1310) is a male. Other specimens are from the same locality early in 1925 and also from Hodges Lake, Calif.

Description.—Body slender, ranging from 12 to 20 mm in length and from 0.6 to 0.8 mm wide. Number of segments, 43 to 64, the smallest specimen being a male with 43 segments. Living color grayish white.

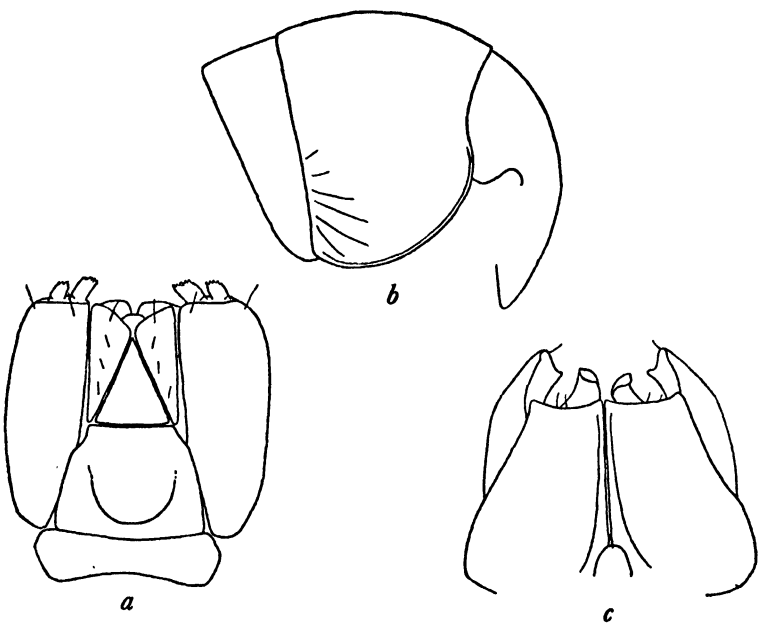


FIGURE 16.—*Pharodere radiata*, new genus and species: *a*, Gnathochilarium, the hypostoma not shown; *b*, head and first two segments, lateral view; *c*, gonopods, anterior view.

Antennae with joint 2 longest; joint 5 next in length and widest of all; joints 3 and 4 subequal in length and shorter than joint 6. Labrum a little depressed below the level of the clypeus, especially at the middle, and with a row of 14 setae across the base. Mandibulary stipes large but receding beneath the head, the upper part of each stipe a little convex but the surface above the lower marginal rim distinctly hollowed for the reception of the antennae. Head and first two segments shown in lateral view in figure 16, *b*.

First segment with the posterior margin noticeably emarginate at middle; lateral surface with six striae radiating from a short space

along the posterior margin a little way above each corner, the lower striae about a third as long as the dorsum, the upper ones shorter and pointing obliquely upward; remainder of surface with minute impressed lines forming a very inconspicuous network visible only with rather high magnification.

Segment 2 with a few fine striations low on the sides, the dorsum smooth. Segment 3 also smooth but with the lateral striations extending above the line of the pores of the poriferous segments.

Segments near the back end of the body with the pair of large, inner, dorsal crests and the lateral carinae more elevated than on the median segments and terminating in right-angled corners, but not projecting beyond the posterior margin of the segments. Penultimate segment a little shorter than the foregoing segment and with the crests and carinae almost as strong.

Gonopods as shown in figure 16, *c*.

ODACHURUS, new genus

Type.—*Odachurus petasatus*, new species, from southern California.

Diagnosis.—Closely related to *Pharodere*, with which it was found. It differs in the flaring anterior corners and swollen surface of segment 1, which lacks lateral striations; the less prominent dorsal ridges of the principal body segments, although on several segments preceding the penultimate the inner pair of ridges and the lateral carinae are produced beyond the posterior margin; penultimate segment short and smooth.

Description.—Body the same shape and size as *Pharodere*. Head with the labral and clypeal setae broken off but otherwise not differing notably from *Pharodere*. Gnathochilarium not dissected, but apparently the mentum is in two parts.

First segment with the anterior corners obtusely rounded and inconspicuously produced forward, very distinctly flaring outward away from the sides of the body, when seen from in front or above, and forming the widest part of the segment; side margins very oblique, with a raised marginal rim visible only in front as the posterior half of the margin abruptly rolled under; posterior corners quite sharp and slightly flaring away from the sides of the body instead of clasping it as in other genera; dorsal surface inflated, especially in front of the median part of the posterior margin which is partly hidden from above; lateral surface without striae.

Segments 2, 3, and 4 forming a neck gradually narrowed to the posterior margin of segment 4, which is only three-fourths the width

of the first segment across the anterior corners. Segments 2 and 3 nearly flat longitudinally, without a transverse constriction; lateral striae reaching to the edge of the dorsum on segment 3. Segment 4 with a transverse constriction, the posterior subsegment moderately convex and with ridges arranged as on the ensuing segments but fainter.

From segment 5 to the caudal end of the body the anterior subsegments are as in *Pharodere*, with anterior portion coarsely reticulate, the posterior part longitudinally channeled, each channel containing a rounded pit behind. Posterior subsegments abruptly raised from the transverse constriction, the dorsum a little convex, with ridges disposed as in *Pharodere* but less definite in shape; a large ridge on each side of the middle, the pair widely separated; between each large ridge and the lateral carina are two or three smaller, lower ridges; all ridges arising from the front of the subsegment but not reaching the posterior margin on any but the hindmost segments; posterior margin flat and lower than the surface between the ridges. On several segments immediately preceding the penultimate segment the large median crests increase in size and project beyond the hind margin, the other ridges becoming less evident and not projecting. Pores beginning on segment 5, borne in a very small and shallow depression in the broad margin of the lateral carinae. Lateral carinae of less definite shape than in *Pharodere*, especially on the anterior segments, where they are little more than rounded swellings; on the posterior segments they are more flattened than on segments farther forward, but each is strongly produced beyond the hind margin as a triangular tooth. Below the lateral carinae numerous prominent striae reach to the feet. Penultimate segment very short and without ridges or lateral carinae.

Last segment long; dorsum nearly flat longitudinally; the thickened apex angularly rounded, a little projecting beyond the valves and with two setae.

Anal valves inflated and meeting in a rather broad, deep groove; each valve with two setae near the opening. Preanal scale very short; the hind margin straight across, the front margin broadly rounded; processes small, each with a short seta.

ODACHURUS PETASATUS, new species

FIGURE 17

A single mature female specimen collected with specimens of *Pharodere* and *Leiodere* beneath stones on the cliffs above the sea

at Torrey Pines, La Jolla, Calif., November 26, 1925, by Dr. O. F. Cook and H. F. Loomis. Type: U.S.N.M. no 1311.

Description.—Body about 14 mm long and 0.7 mm broad. Number of segments, 51. Color in life whitish gray.

Head and first segments shown in figure 17, *a* and *b*.

Segment 1 has the posterior edge distinctly emarginate medianly, but the pronounced inflation of the dorsal surface immediately in front of it hides much of the margin from above.

From segment 5 to near the caudal end of the body the posterior portion of the anterior subsegments is longitudinally marked with channels nearly twice as long as wide, each usually containing a rounded or oval pit behind; channels separated from each other by a thin, raised ridge. On the anterior poriferous segments the lat-

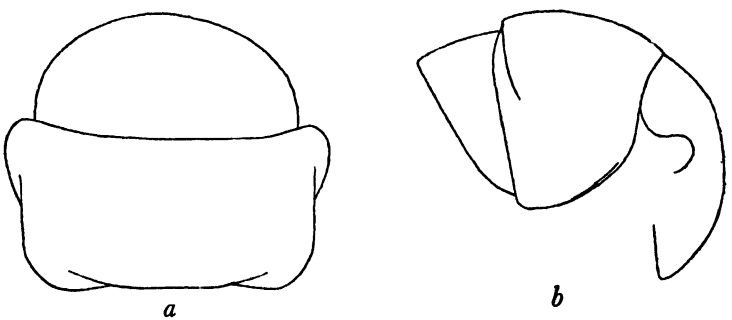


FIGURE 17.—*Odachurus petasatus*, new genus and species: *a*, Head and segment 1, dorsal view; *b*, head and first two segments, lateral view.

eral carinae are rounded swellings, but toward the middle of the body, although low and not abruptly raised from the surface, they become more definite in outline, being distinctly obovate yet not reaching the back margin, as they do on several of the caudal segments, where they project beyond the margin as acute teeth. Antepenultimate segment with the two large dorsal ridges reduced in size but strongly projecting beyond the back margin as teeth. Penultimate segment less than half as long as the foregoing segment and without dorsal ridges or lateral carinae.

Last segment nearly as long as the three preceding segments together, the thickened tip angularly rounded, projecting a little beyond the valves and with two small apical setae. Preanal scale at least four times broader than long; hind margin straight, front margin rounded; process on each side inconspicuous.

Family CAMBALOPSIDAE

The members of this family differ most fundamentally from those of the Cambalidae in the possession of an undivided mentum. The family has hitherto been known only from southeastern Asia, but the discovery of four new species in California greatly extends the distribution, no forms being known as yet from the intervening countries. Two new genera have been required for the inclusion of these species in the classification system, the genus *Endere* having eyes, recessed mandibulary stipes, and very strongly constricted neck segments, in contrast to the genus *Leiodere*, with its lack of eyes, convex mandibulary stipes, and much less strongly constricted neck segments, to mention only a few diagnostic points.

ENDERE, new genus

Type.—Endere disora, new species, from California.

Description.—Body slender, about 18 times as long as broad; distinctly moniliform and a little depressed, as seen in cross section.

Head with ocelli in a single series covered by the anterior margin of segment 1. Antennae (fig. 18, *a*) short, subclavate, broadly separated, inserted on the sides of the head rather than on the dorsolateral surface, the bases not exposed from above (fig. 18, *b*). Clypeus with six setae. Labrum depressed below the level of the clypeus, tridentate, with sixteen short setae across base. Gnathochilarium (fig. 18, *c*) with mentum entire, nearly as long as the stipes, the upper fourth decidedly attenuated and reaching to near the tips of the lingual laminae, median surface with a rounded depression deepening behind; stipes without a distinct outer angle, the sides continuous, broadly and evenly rounded from the outer papillate process to the base; lingual laminae slender, about half as long as the stipes. Mandibulary stipes inconspicuous beneath the lateral margin of the head, the surface distinctly depressed to receive the antennae; lower margin with a raised rim.

Segment 1 broad and longer than the next three segments combined; anterior corners prominent, produced forward, broadly rounded; posterior corners nearly right-angled, produced backward slightly and strongly curved under the body; lateral margin descending obliquely from in front to just behind the middle, where it bends upward, forming an obtuse rounded angle, margin with a faint rim; lateral surface without striations. Head and first five segments shown in lateral view in figure 18, *d*.

Segments 2, 3, and 4 flattened, scarcely convex, lacking the transverse constrictions of the succeeding segments, the sides rapidly

converging backward to the hind margin of segment 4, which is only two-thirds as wide as the widest part of segment 1; ensuing segments abruptly larger. First six segments shown in dorsal view in figure 18, *e*.

From segment 5 to the caudal end of the body the posterior subsegments are conspicuously raised above the anterior subsegments and are more convex, with a low, tumid swelling on each side of the middle and a lateral swelling or prominence bearing the pore (fig. 18, *f*). Pores beginning on segment 5, small and lacking an encircling rim.

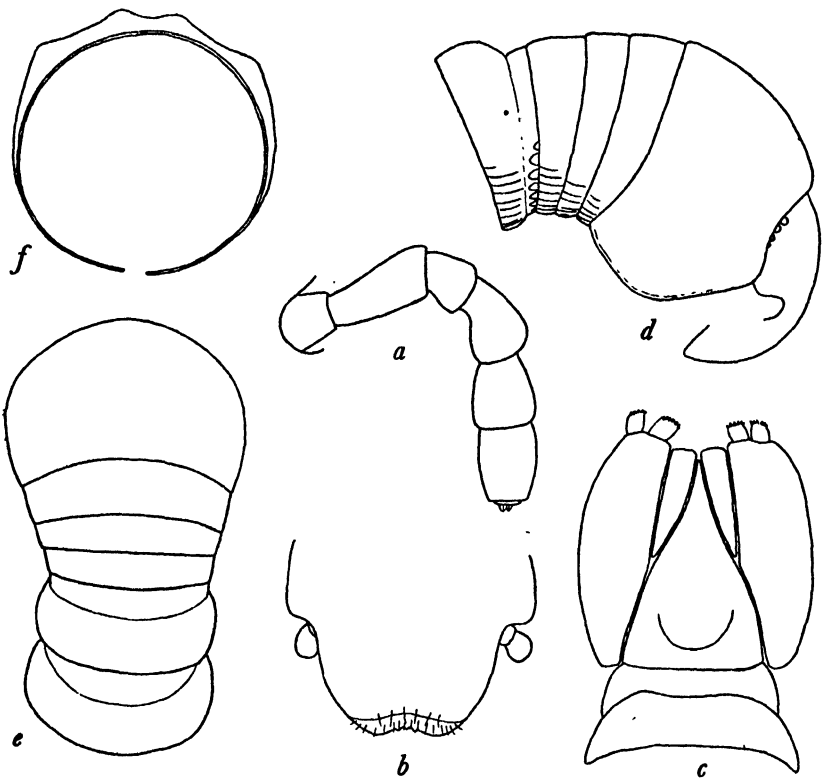


FIGURE 18.—*Endere disora*, new genus and species: *a*, Antenna; *b*, anterior portion of head; *c*, gnathochilarium; *d*, head and first five segments, lateral view; *e*, first six segments from above; *f*, midbody segment, posterior view.

Last segment long, the apex even with the valves; setae of indeterminate number have been rubbed off.

Anal valves moderately inflated and meeting in a broad, deep groove.

Preanal scale a transverse ellipse; the process on each side large.

Males unknown.

ENDERE DISORA, new species

FIGURE 18

A single female specimen collected in an ant nest at Sunnyside Mine, near Seneca, Plumas County, Calif., December 19, 1922, by H. S. Barber. Type: U.S.N.M. no. 1312.

Description.—Body 18 mm long and 1 mm broad; slightly flattened; number of segments, 46. Color of body in alcohol light yellow throughout, indicating that it probably was nearly white in life.

Head smooth and shining; vertex unimpressed; antennae widely separated, the distance between them nearly equal the length of one antenna; antennae rising from beneath the lateral margin of the head, the sockets and most of the first joints hidden from above; joints 1 and 3 subequal in length, shorter than the subequal joints 4 and 5; joint 2 longest, a third longer than joint 6; joint 7 very short, scarcely exposed; joints 4, 5, and 6 of nearly equal diameter; mandibulary stipes obscured from above by the sides of the head.

Segment 1 smooth and shining; anterior margin straight and thickened; posterior margin straight across the median part but bending caudad some distance above the hind angles, which are somewhat produced backward.

From segment 5 to the caudal end of the body the segments are strongly constricted at middle; anterior division of each segment moderately convex, with a series of very shallow, indistinct, oblong channels behind, the channels separated by very fine raised lines slightly beaded along their crests; in front of the channels the surface is marked with distinct honeycomb reticulations. Posterior subsegments more elevated, exceedingly convex, without distinct crests but with a broad, tumid swelling on either side of the median line, the swelling gradually raised from in front to the middle; dorsal surface with smaller and less conspicuous reticulations than the anterior subsegment. Pores beginning on segment 5, borne on the anterior slope of a lateral prominence similar to that on each side of the dorsum. Sides longitudinally striate below the pores, especially on the anterior segments. Body narrowing rapidly backward at the last three segments.

Antepenultimate segment slightly longer and a little more convex than the next segment but not so convex as the one before; dorsal elevations not evident, and the pore not on a prominence as on the foregoing segments.

Last segment a little longer than the two preceding segments combined, the apex strongly rounded behind, the setae lost. Preanal scale elliptic and relatively long, being two-fifths as long as broad; the processes that project from under the margin of the last segment and cover the lateral angles of the scale are large and conspicuous.

LEIODERE, new genus

Type.—Leiodere torreyana, new species, from southern California.

Description.—Body slender, 15 to 25 times as long as broad, submoniliform; surface smooth, without distinct dorsal ridges.

Head without eyes; antennae rather short and subclavate; clypeus with four large setae; labrum with 14 smaller setae; gnathochilarium with the sides converging toward the base, the mentum entire; mandibulary stipes hidden from above, slanting under the head, slightly convex and with a fine raised rim below.

First segment nearly as long as or longer than the next three segments together; with definite anterior and posterior corners, the latter somewhat clasping the sides of the body; lateral margin straight and with a raised rim.

Segments 2, 3, and 4 constricted caudad, forming a more or less distinct neck; dorsum flat longitudinally, not at all convex. Succeeding segments with the posterior subsegment convex, abruptly elevated from the constriction above the anterior subsegment, causing the body to appear submoniliform. In two of the species there is a general swelling of the surface on each side of the middle of the dorsum, with a concomitant median depression; the other species, having no dorsal swelling, lacks the median depression. Pores small, beginning on segment 5, the general surface about the pore slightly more convex than elsewhere, sometimes even raised into a noticeable swelling. Lateral striae not reaching to the pore on any segment.

Last segment as long as or longer than the two preceding segments together; each lateral margin containing a seta and four to eight setae in the apical margin; apex rounded and not projecting beyond the anal valves.

Anal valves moderately convex, the margins meeting in a groove. Preanal scale transversely subelliptic. A process on each side of the scale but not prominent.

First pair of male legs slightly reduced, 6-jointed, the terminal claw normal.

KEY TO THE SPECIES OF LEIODERE

1. Body small, less than 15 mm in length; 40 segments or less; antennae with joint 2 longest nana, new species
 Body 15 mm or more long; segments more than 40; antennae with joint 2 equaled or exceeded by at least one other joint 2
2. Dorsum of segments with a shallow median depression, bounded on either side by a broad, indistinct swelling; first segment longer than next three segments combined; last segment with 8 apical setae dasyura, new species
 Dorsum of segments lacking broad swellings or a median depression; first segment shorter than next three segments combined; last segment with 4 apical setae torreyana, new species

LEIODERE TORREYANA, new species

FIGURE 19; PLATE 2, FIGURES 4, 5

Numerous specimens, including the male type (U.S.N.M. no. 1313), collected at Torrey Pines, La Jolla, Calif., January 11, 1925, by H. G. McKeever and A. D. Harvey. Others collected by Dr. O. F. Cook and H. F. Loomis at the same locality beneath stones on the cliffs above the sea, intermixed with specimens of *Pharodere radiata* and *Odachurus petasatus*, November 26, 1925. Other specimens from 20 miles below Tia Juana, Lower California, January 1925 by Dr. O. F. Cook.

Description.—Body 20 to 26 times as long as broad; a large female 21 mm long, 0.8 mm broad, with 58 segments; another mature specimen has only 43 segments. Color in life dusky cream-white.

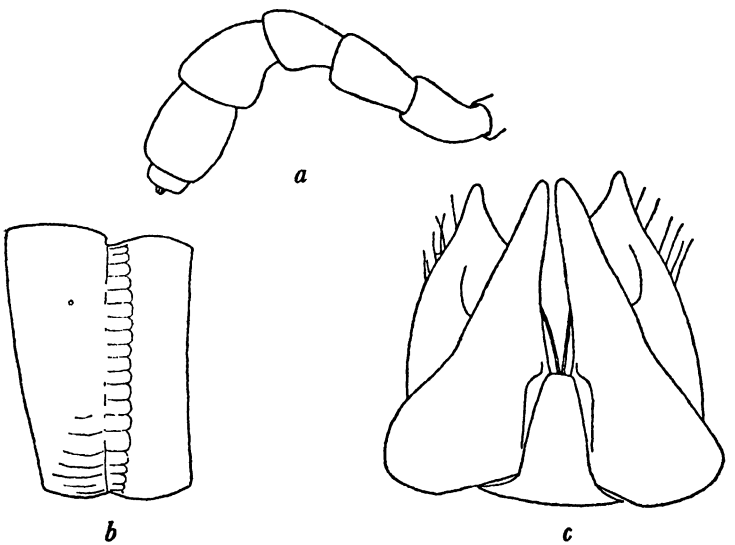


FIGURE 19.—*Leiodere torreyana*, new genus and species: *a*, Antenna; *b*, midbody segment, lateral view; *c*, gonopods, anterior view.

Head eyeless, surface smooth and shining. Antennae (fig. 19, *a*) short and subclavate, separated by a distance equal to over half their length; joints 2, 3, 5, and 6 subequal in length; joint 4 shorter than any except the basal and apical joint, the latter a fifth as long as joint 6; joint 5 widest. Labrum depressed at middle below the level of the clypeus. Mandibulary stipes not prominent, slanting slightly inward, the surface faintly convex and coarsely reticulated. Gnathochilarium with sides almost parallel, converging toward the base much less than in the other species.

First segment as long as or a little longer than the next three segments together; anterior edge subemarginate; lateral margin ex-

tending obliquely downward in an almost straight line and with a narrow rim reaching from around the anterior corner to the posterior corner, which is almost a right angle and not conspicuously clasping the side of the body and lacking pronounced striations.

Segments 2, 3, and 4 forming a moderately constricted neck, the posterior margin on segment 4 five-sevenths as wide as the first segment at its broadest part. Segments 2 and 3 flat, without transverse constrictions; segment 4 with a constriction behind which the surface is more convex.

Anterior division of the subsequent segments quite convex; a series of shallow channels along its posterior part, the channels less than twice as long as broad, smooth within, separated by fine, raised, beaded lines; anterior part of subsegment coarsely reticulated; posterior subsegment abruptly raised from the constriction considerably higher than the anterior subsegment, strongly convex; dorsal surface appearing smooth and shining but with correct magnification and lighting numerous short, irregular, impressed lines appear, which, when well developed, form reticulations having meshes longer than broad. A segment from the middle of the body is shown in figure 19, *b*. Pores beginning on segment 5, placed on a very slight swelling high on each side; on the anterior segments the pore is in front of the middle of the subsegment, but farther back it is at the middle. Sides below the pores finely striate longitudinally, the striae of the anterior segments farthest up the sides.

Antepenultimate segment less convex than preceding but more so than the nearly flat penultimate segment.

Last segment longer than the two preceding segments together; posterior margin broadly rounded, with four apical setae and another seta on each side.

Anal valves strongly inflated; margins meeting in a narrow, shallow groove. Preanal scale over three times broader than long; front margin rounded more than the back margin; tab process on either side large.

Gonopods as shown in figure 19, *c*.

Segment 6 of male with pleurae not produced backward; segment 7 with the opening for the gonopods U-shaped, its margin strongly elevated.

LEIODERE NANA, new species

FIGURE 20

Numerous specimens, including the male type, U.S.N.M. no. 1314, were collected between Vallejo and Cordelia, Calif., January 4, 1928, by Dr. O. F. Cook, who also collected a male and two females at Cordelia on February 20, 1929.

Description.—Body long and slender, 9 to 13 mm long and 0.6 to 0.9 mm broad; cylindrical, not at all flattened as seen in cross section; number of segments 32 to 40; living color light grayish white with a series of internal orange spots, the repugnatory glands, showing through the body wall.

Head with the antennae quite short and stout (fig. 20, *a*), arising from the dorsolateral surface, the basal joint almost entirely exposed from above; joint 2 longest; joints 5 and 6 subequal, next in length; joints 3, 4, and 1 decreasing in order named; joint 5 broadest.

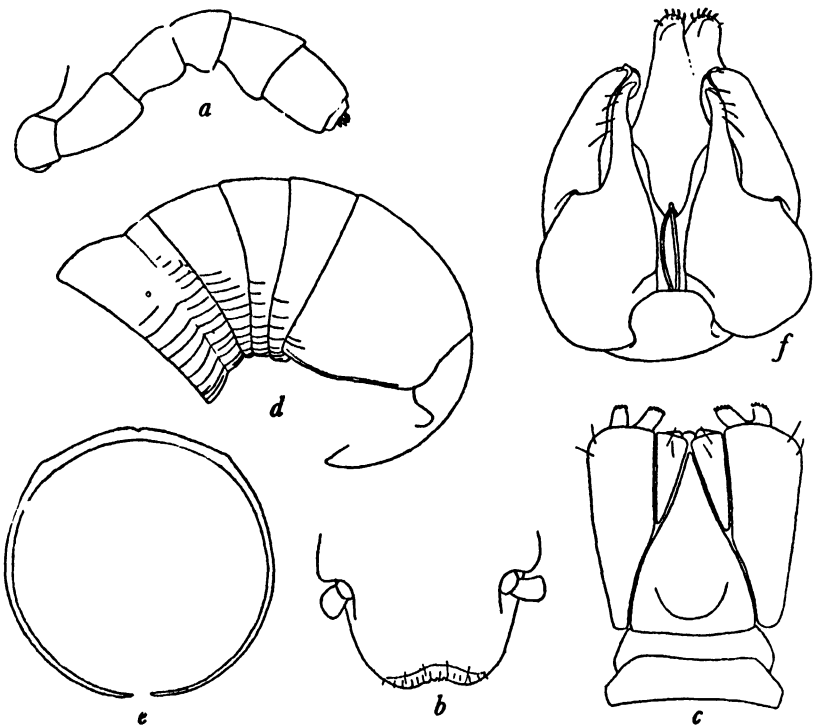


FIGURE 20.—*Leiodere nana*, new genus and species: *a*, Antenna; *b*, anterior portion of head; *c*, gnathochilarium of male; *d*, head and first five segments, lateral view; *e*, mid-body segment, posterior view; *f*, gonopods, anterior view.

Clypeus with two setae on each side. Labrum almost continuous with the clypeus, scarcely depressed, with 14 setae across the base. Anterior portion of head shown in figure 20, *b*. Gnathochilarium as shown in figure 20, *c*.

First segment little longer than the next two segments together; the anterior corners broader than a right angle and slightly produced forward; lateral margin obliquely descending to near the hind angle, where it is bent horizontally, the margin with a raised rim; posterior corners square, slightly curved under the side of the body,

two short rudimentary striae sometimes present in the angle; back margin straight throughout its length. Anterior segments shown in lateral view in figure 20, *d*.

Segments 2, 3, and 4 flat, without transverse constrictions; sides slightly narrowing backward, the posterior margin of segment 4 about ten-thirteenths as wide as the widest part of segment 1; lateral striae reaching higher on segments 4 and 5 than on any other segment.

From segment 5 to the antepenultimate segment strong transverse constrictions are present; anterior subsegments moderately convex, with coarse reticulations in front sometimes showing through the semitransparent posterior subsegments, and with shallow rectangular channels behind, twice as long as broad and separated by fine, raised, and very inconspicuously beaded lines. Posterior subsegments with fine median sulcus, more impressed on the back half; surface shining and with many tiny impressed longitudinal lines except on the extremely faint lateral swelling where a considerable area around the pore is dull and conspicuously reticulated. Posterior view of a segment from near the middle of the body is shown in figure 20, *e*. Pores beginning on segment 5, borne on the anterior slope of the faint swelling, the pore minute, without an encircling rim. Penultimate segment much shorter and less convex than the preceding segment, the anterior subsegment exposed only on the sides.

Last segment as long as the two preceding segments together; the apex rather narrowly rounded and exceeded by the anal valves, with four apical setae but none on the side margins.

Anal valves moderately inflated, meeting rather abruptly in a narrow, shallow groove. Preanal scale less than half as long as broad; processes relatively large.

Gonopods as shown in figure 20, *f*.

First male legs reduced in size but with fully developed claws. Other pregenital legs without special modifications.

Genital segments prominent below; the back margins of the broad, overlapping pleurae of segment 6 continuous with the back margin elsewhere, not produced caudad; opening in segment 7 biarcuate behind, the surrounding margin strongly raised.

LEIODERE DASYURA, new species

FIGURE 21; PLATE 2, FIGURE 2

Several specimens, including the male type (U.S.N.M. no. 1315), collected at Tajiguas, Calif., January 1, 1928, by Dr. O. F. Cook, who also collected a male east of San Lucas, Calif., December 20, 1930.

Description.—Body slender, 15 to 18 mm long and 0.8 to 1 mm broad; females a little stouter than the males; body cylindric, com-

posed of 41 to 51 segments; living color light grayish white, with a series of internal orange spots, the repugnatorial glands, showing through the body wall on each side.

Head with antennae rising from the dorsolateral surface; especially slender at base; joint 2 shorter than any of the next four; joint 5 longest and broadest (fig. 21, *a*). Clypeus with two large setae each side. Labrum nearly continuous with the clypeus, a series of 14 short setae across base. Mandibulary stipes slanting inward and downward from the lower margin of the head; with a fine marginal rim; surface definitely convex. Gnathochilarium as shown in figure 21, *b*.

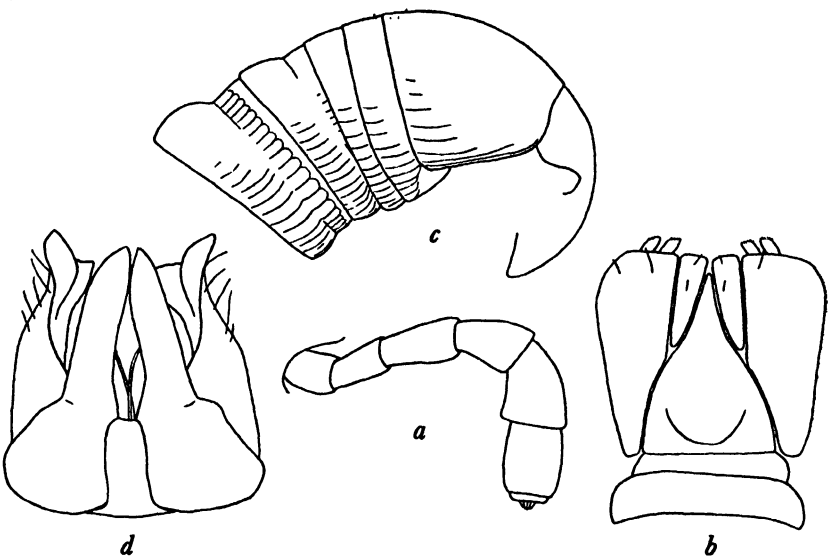


FIGURE 21.—*Leiodere dasyura*, new genus and species: *a*, Antenna; *b*, gnathochilarium; *c*, head and first five segments, lateral view; *d*, anterior gonopods, anterior view.

First segment with the dorsum two-thirds longer than the lateral margin and longer than the next three segments together; anterior corners rounded and somewhat produced forward; lateral margin nearly horizontal, with a raised rim; hind angles squarely rounded, scarcely curved under the sides of the body; posterior margin straight its entire length; lateral surface with 5 to 10 striae directed forward from the back margin just above the angle, the lower striae longest. Anterior segments shown in lateral view in figure 21, *c*.

Segments 2, 3, and 4 strongly constricted, necklike; the back margin of segment 4 only three-fourths as wide as the broadest part of segment 1; segments 2 and 3 with the dorsum flat, without transverse constrictions; segment 4 with the constriction evident, the anterior subsegment exposed and the posterior subsegment much more convex but lacking the swellings of the ensuing segments.

From segment 5 to the caudal end of the body the channels at the back of the anterior subsegments are large and conspicuous, about twice as long as broad, and separated by distinctly beaded raised lines; in front of the channels the surface is coarsely reticulated. Posterior subsegments strongly convex, the caudal ones decreasingly so, the penultimate segment nearly flat; surface of subsegments slightly rough, with rather coarse reticulations; dorsum on each side of the middle swollen, the two inconspicuous prominences separated by a depression which is broader and deeper on the front of the subsegment; high on each side, almost on the dorsum, is a slightly less apparent swelling with the pore on its anterior slope; pores beginning on segment 5, small, without a raised rim; lateral striations strong and conspicuous, reaching nearly to the pores on segments 4 and 5 but still apparent low on the sides of the caudal segments.

Last segment slightly longer than the two preceding segments together; the apex rather narrowly rounded and with eight setae projecting from the margin; each side with an additional setae.

Anal valves rather strongly inflated and meeting in a broad, deep groove. Preanal scale only a third as long as broad; front margin rounded, the back margin straighter; processes at the lateral angles small.

Gonopods as shown in figure 21, *d*.

First pair of male legs small and with well-developed claws; other legs without secondary sexual characters. Genital segments rather prominent below; the pleurae of segment 6 somewhat raised over the opening in segment 7 but not produced backward; opening in segment 7 slightly biarcuate behind, its margin strongly raised.

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POLYCLADS OF THE EAST COAST OF NORTH AMERICA [1]

By A. S. Pearse

Between June 1935 and May 1936, while I was investigating the flatworms known to the oystermen of Florida as "leeches," a number of species of these polyclads were found along the shores of the Gulf of Mexico. In attempting to identify these specimens, I examined turbellarians in the United States National Museum, and the present paper is the result. Twenty-seven species of the order Polycladida are now known from the east coast of North America from Texas to Baffin Bay. Eleven species and three genera are here described as new.

Grateful acknowledgments are made to George W. Wharton, who prepared serial sections and made valuable suggestions; to Miss Eliza Taylor, for serial sections of *Eustylochus;* and to Prof. Horace W. Stunkard, who read the manuscript of this paper critically and suggested several improvements.

Order POLYCLADIDA

Suborder ACOTYLINA: Section CRASPEDOMMATA

Family DISCOCELIDAE

Genus DISCOCELIS Ehrenberg

DISCOCELIS GRISEA, new species

FIGURE 22

A dozen specimens were collected from the Gulf of Mexico on November 21, 1935, and one on February 10, 1936. When alive, an

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individual of this species looked somewhat like *Stylochus inimicus* Palombi but was easily distinguished by the quicker movements and the fact that when crawling the anterior end was wider than the posterior, so that the shape of the body was oval. The largest individual was 18 mm long and 5 mm wide when extended. The color of the

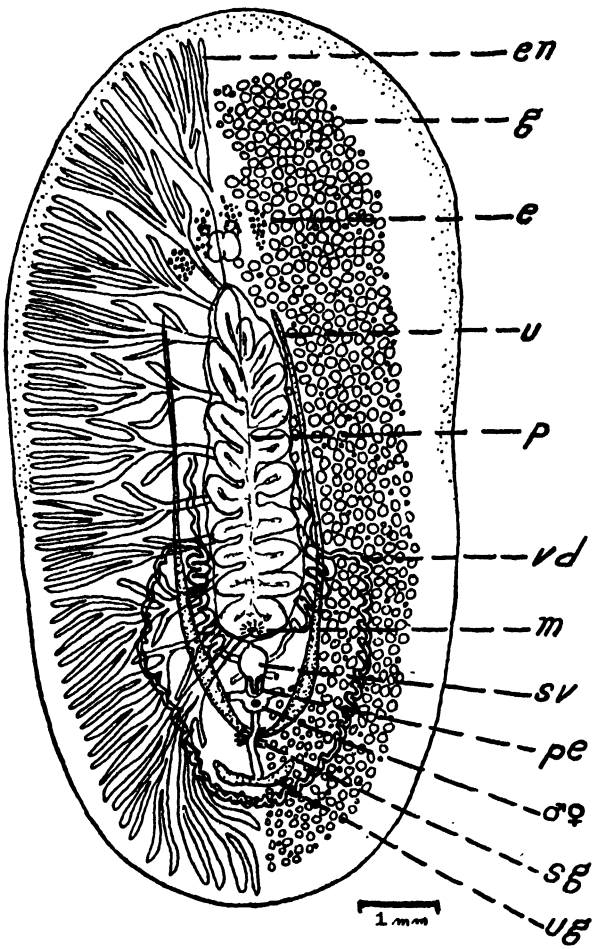


FIGURE 22.—*Discocelis grisea*, new species: Enteron at left, gonads at right. *e*, Eyes; *en*, enteron; *g*, gonads; *m*, mouth; *p*, pharynx; *pe*, penis; *sg*, shell gland; *sv*, seminal vesicle; *u*, uterus; *ug*, uterine glands; *vd*, vas deferens; ♂, male opening; ♀, female opening.

dorsum was gray, with faint radiating light streaks (nerves) and a light median band (pharynx, etc.) through the middle half. The ventrum was cream-color, with white genitalia showing through. At times the worms swam about by waving the sides of the body. There were no nuchal tentacles, but the tentacular eyes were in low tubercles.

Preserved, stained, and mounted, the type measures 11.6 mm long and 5.8 mm wide. The structures in the median line are the following distances from the anterior end: Brain, 2.7 mm; pharynx, 3.5–8.2 mm; mouth, 8.0 mm; male genital bursa, 8.2–8.8 mm; genital opening, 8.9 mm; shell gland, 9.4 mm; accessory uterine organs, 9.9 mm; posterior loop of vasa deferentia, 10.2 mm. The cerebral and tentacular eyes are arranged in two pairs of lateral groups, about 15 in each; about 350 marginal eyes extend along the sides from the anterior end about halfway to the posterior end.

The pharynx is folded into about 10 lobes and is rather narrow; 1.0 by 5.1 mm. Ten pairs of branched, lobate caeca arise from the median stem of the enteron dorsal to the pharynx and extend to the margins of the body. The mouth is ventral, just anterior to the posterior border of the pharynx.

Close behind the mouth the prostate gland and penis are enclosed in a pyriform sheath with two to four lateral appendages. The coiled vasa deferentia extend forward from the prostate gland close beside the pharynx. At about the posterior third of the pharynx each gives off a lateral branch, which coils posteriorly and fuses with the one from the opposite side behind the accessory uterine organs. The vagina, behind the single genital pore, is surrounded by shell-gland follicles. Two lateral, longitudinal uteri extend forward from the shell gland along the sides of the pharynx. None of those available contain eggs, and all taper gradually toward the anterior. Behind the shell gland a slightly sinuous median duct connects with a pair of transverse accessory uterine organs, which are usually curved anteriorly near their distal ends. Numerous ovaries and testes are distributed in a ring around the pharynx and genital ducts, leaving a zone about 0.7 mm wide free about the margin.

Type.—U. S. N. M. no. 20186, from Crooked Island Sound, Farmdale, Fla.; collected November 21, 1935, by A. S. Pearse.

Remarks.—This species differs from *Discocelis mutabilis* Verrill, 1873, in having the cerebral and tentacular eyes arranged in two pairs of groups and in being colored with radiating light streaks and a lighter median band.

Family STYLOCHIDAE

Genus STYLOCHUS Ehrenberg

STYLOCHUS INIMICUS Palombi

FIGURE 23

Stylochus inimicus PALOMBI, 1931, p. 219.

As Palombi has given a complete description of this species and as I have published (1938) a paper on the general ecology of this

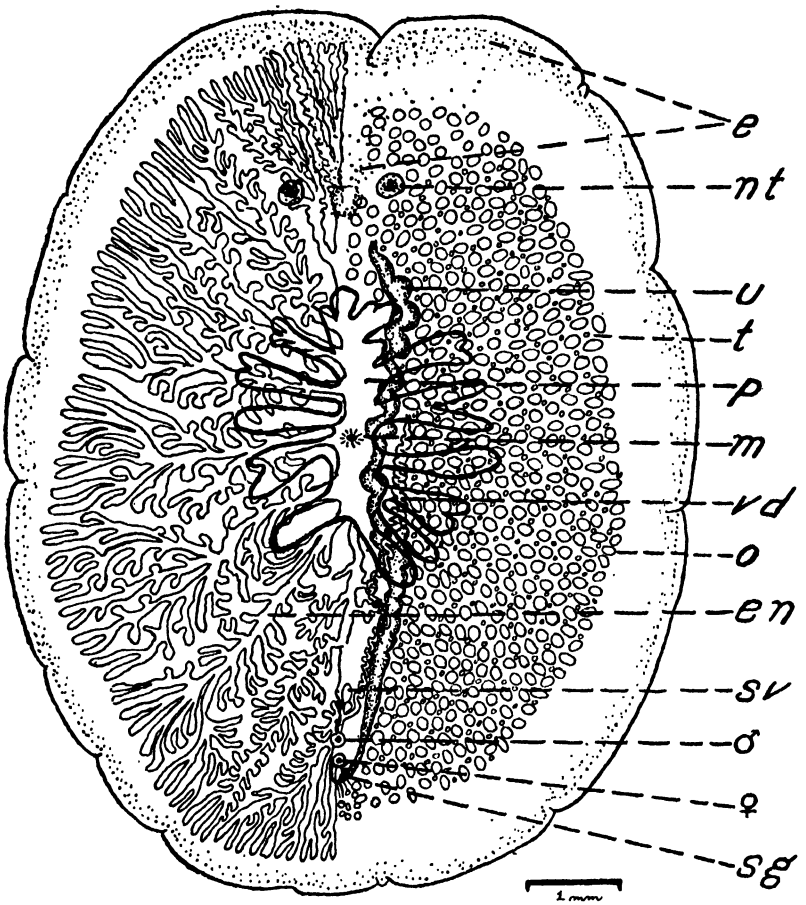


FIGURE 23.—*Stylochus inimicus* Palombi. *e*, Eyes; *en*, enteron; *m*, mouth; *nt*, nuchal tentacles; *o*, ovary; *p*, pharynx; *sg*, shell gland; *sv*, seminal vesicle; *t*, testis; *u*, uterus; *vd*, vas deferens; ♂, male opening; ♀, female opening.

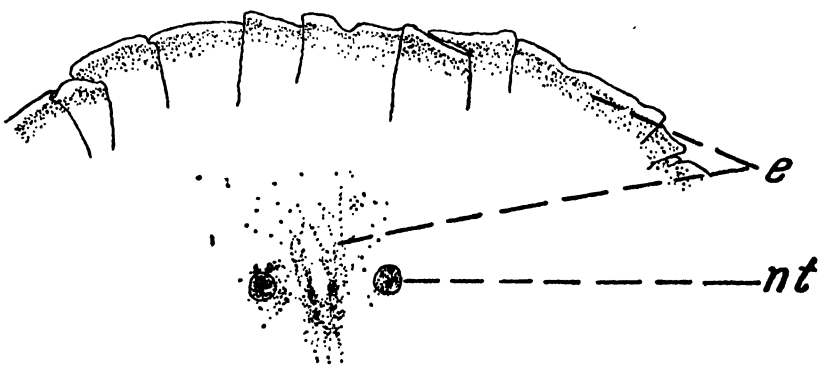


FIGURE 24.—*Stylochus floridanus*, new species: Anterior end showing eyes (*e*) and tentacles (*nt*).

polyclad and its relations as an oyster pest, it is discussed here but briefly. It is common on oyster beds, especially in summer and during dry periods when estuarine salinities are high, from Apalachicola Bay along the coast of Florida to Indian River. Palombi (1936) has described *S. tenax* from Apalachicola Bay. After examining specimens from the same locality and comparing them with others from the localities from which he describes *S. inimicus*, I am convinced that all belong to one species. The characters that Palombi cites as different are variable. Perhaps this may be explained by the fact that he studied two lots of worms; one was preserved in alcohol, the other in formol.

STYLOCHUS FLORIDANUS, new species

FIGURE 24

Body of largest specimen observed alive, expanded and actively creeping; length, 53 mm; width, 27 mm. Five preserved specimens measure: 31 by 24.5, 30 by 22, 29 by 21, 23 by 22, 20.5 by 13.5 mm. The margins of the body are always more or less thrown into small folds. The nuchal tentacles are 0.7 mm long when extended. They average about a fifth of the length of the body from the anterior end. They are conical, and each tapers to a rather sharp tip. The enteron has a median stem and branching lateral caeca, which extend to near the margins of the body; the mouth is on the median line about two-fifths of the length of the body from the anterior end; the pharynx is thrown into about 10 pairs of lateral folds. There are groups of from 40-odd to more than 100 eyes in and about the base of each nuchal tentacle. A more or less circular group of about 160 eyes surrounds the brain and leaves a clear space in the middle. Peripheral to this group, eyes are scattered, and these decrease in number centrifugally. Many marginal eyes extend completely around the body. These are more numerous and somewhat larger toward the anterior end and are least numerous at about the junction of the middle and posterior thirds.

The male genital opening is about 0.5 mm in front of the female opening. Both are on the median line about one-seventh of the length of the body from the posterior end. Anterior to the male opening there is a short conical penis and a pyriform prostate gland. The vasa deferentia coil along the lateral margins of the pharynx, unite posterior to it, and enter the penis through a sinuous tube. The gonads and uteri do not show well in any of the specimens available. Behind the female opening there is a small globular vesicle.

The color of living specimens is pink. The dorsum is covered with small pink spots, which measure 0.1 by 0.1 mm to 0.1 by 0.6 mm

and show a tendency to be more elongated toward the margins. These are surrounded by a cream-colored background. The body appears slightly darker over the pharynx and median portion of the gut. There are no spots over the brain. The ventrum is creamy, with a slightly reddish tint. The pharynx and vasa deferentia show as whitish areas.

Type.—U.S.N.M. no. 20187, from St. Vincent Bar, Apalachicola Bay, Fla.; collected June 12, 1935, by A. S. Pearse.

Remarks.—Seven specimens were collected on the oyster beds in Apalachicola Bay, June 7 to July 25, 1935. Five of these are deposited in the United States National Museum. This species was rather rare, for during the same period hundreds of specimens of *Stylochus inimicus* Palombi were found. In color it is somewhat like the species that Verrill (1873) described as "*Stylochus*" *littoralis*, but its tentacles are farther anterior, the size is larger, and the distribution of the eyes is different.

STYLOCHUS ZEBRA (Verrill)

Stylochopsis zebra VERRILL, 1882, p. 371.

Several specimens of this species were obtained from Woods Hole, Mass., and are now deposited in the United States National Museum.

Genus EUSTYLOCHUS Verrill

As Bock (1925), Bresslau (1933), and Meixner (1907) have pointed out, the Stylochidae consist of a heterogeneous collection of Craspedommata, a fact that makes the separation of various species into genera rather difficult. Notwithstanding the fact that these writers do not recognize Verrill's (1893) genus *Eustylochus*, it seems to me proper to do so. The Stylochidae on the east coast of North America appear to fall into two groups: (1) Those in the genus *Stylochus* have two genital pores, which are clearly separate and lie more than a seventh of the length of the body from the posterior end, and have marginal eyes around the whole body, weak dermal musculature, and ovaries ventral; (2) those in the genus *Eustylochus* have genital pores very close together and less than a twentieth of the length of the body from the posterior end, usually have marginal eyes only around the anterior half, heavy dermal musculature, and ovaries dorsal. George W. Wharton has bred out larvae from the eggs of *Stylochus inimicus* Palombi and *Eustylochus meridianalis*, new species. He finds that at the time of hatching the former bears no lobes and that the latter has lobes.

EUSTYLOCHUS ELLIPTICUS (Girard)

Planocera elliptica GIRARD, 1850, p. 251.

In the collection of the National Museum there are five specimens of this species collected on Cape Cod, Mass., in 1879 at low tide mark; and a specimen from Newport, R. I., August 20, 1880. Although these are in poor condition, they were stained, mounted, and used for comparison with specimens of the next two species.

EUSTYLOCHUS species ?

Two poorly preserved specimens in the National Museum collection, one (U.S.N.M. no. 15624) collected off Newport, R. I., September 2, 1880, the other (U.S.N.M. no. 14398) from Woods Hole, Mass., September 19, 1882, both determined by A. E. Verrill as *Planocera nebulosus* Girard, unquestionably belong to the genus *Eustylochus*. They have anterior marginal eyes and contiguous genital pores very close to the posterior end. These specimens probably should be identified with the preceding species, but until someone makes a careful study of the Eustylochi on the New England coast, their status, because of their poor state of preservation, must remain specifically uncertain. For that reason this questioned species has not been included in the key on p. 94.

EUSTYLOCHUS MERIDIANALIS, new species

FIGURE 25

Body elongate-elliptical; very flat; length of a specimen measured while crawling and extended on January 9, 1936, 24.0 mm; width, 11.00 mm; another slender individual measured 20 by 5 mm when crawling; sizes of large preserved specimens are given in the table below. Tentacles in living specimen, slender, conical; with eyes extending to distal sixth; 0.6 mm long; about a seventh of the length of the body from the anterior end. Mouth, ventral and about in the middle of the median line. Pharynx a little less than half as long as the body; with anterior, posterior, and about six lateral lobes. The enteron has a median stem and eight or more branched caeca on each side. Brain largely or wholly posterior to the bases of the tentacles. Eyes vary with age in number and arrangement. The marginal eyes are seldom distributed posteriorly beyond the anterior fifth or sixth of body, but in a few individuals they may be. One individual only 1.8 mm long, which perhaps belongs to this species, has eyes all around its body Seven large individuals show the following arrangement of eyes:

Locality	Body size, mm	Cerebral	Frontal	Tentacular	Marginal
Apalachicola, Fla	13.5 by 11.0	6	22	44	700
Do	14.5 by 11.3	6	8	52	448
Seabrook, Tex	11.0 by 11.0	54	30	150	820
Charlotte County, Fla	9.3 by 6.8	10	12	44	490
Do	9.3 by 7.2	50	44	44	860
Pamlico Sound, N. C	10.0 by 5.8	6	12	60	500
Tampa, Fla	4.7 by 3.0	6	4	22	290

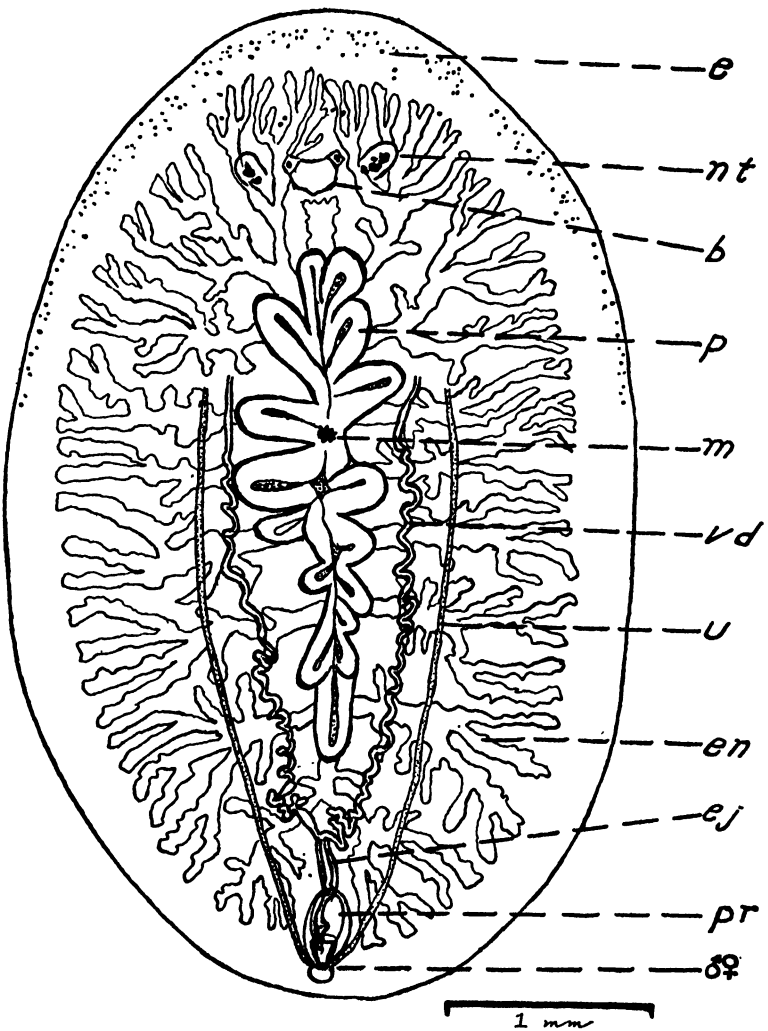


FIGURE 25.—*Bustylochus meridianalis*, new species. *b*, Brain; *e*, eyes; *ej*, ejaculatory duct; *en*, enteron; *m*, mouth; *nt*, nuchal tentacles; *p*, pharynx; *pr*, prostate gland; *u*, uterus; *vd*, vas deferens; ♂, male opening; ♀, female opening.

The genital pores are close together and near the posterior margin of the body, less than one-thirtieth of the length of the body from the posterior end. On each side of the body is a concentric area where numerous small testes occur. The coiled vasa deferentia pass posteriorly on either side of the pharynx. They unite to form a large, slightly coiled, pyriform seminal vesicle, which leads to the strong conical penis, adjacent to the genital pore. The prostate gland lies above the anterior half of the duct on the penis and opens independently. The uteri when empty lie lateral to the vasa deferentia but when distended overlap them. They open into a globular vesicle, which is posterior to the genital pore. Into it open the shell glands. The ovate lobules of the ovaries lie in two crescentic areas lateral to the pharynx, about 170 on each side.

Color reddish brown or, less often, gray; the dorsum finely maculate. A light band, about 0.8 mm wide in a worm 22 mm long, extends down the median line from the anterior tenth to the posterior fifth of the body. This is bordered for about 1.0 mm by a darker region where pigment flecks are thicker. The ventrum is brownish white, somewhat darker toward the margins; the pharynx and parts of the genitalia show as white bodies.

Type.—U.S.N.M. no. 20188, from St. Vincent Bar, Apalachicola Bay, Fla.; collected December 27, 1935, by George W. Wharton.

Remarks.—Specimens of this species have been taken from living oysters by Dr. H. F. Prytherch at Shell Point, Swanquarter, Pamlico Sound, N. C.; J. F. Bass, Bulls Bay, Charlotte County, Fla.; Albert Collier, Seabrook, Tex.; Prof. Clyde T. Reed, Matagorda Bay, Tex.; and by A. S. Pearse in Apalachicola Bay and in the region of Crooked Island Sound, St. Joe Bay, Tampa, Eau Gallie, Englewood, and Crystal River, Fla. In the National Museum collection are specimens from Plumpoint and Island Creek, Talbot County, Md.

This species is readily distinguished from *Eustylochus ellipticus* (Girard) by the position of the brain and the cerebral eyes behind or between the tentacles and by the absence of a reticulate color pattern.

Section SCHEMATOMMATA

Family LEPTOPLANIDAE

Genus NOTOPLANA Laidlaw

NOTOPLANA ATOMATA (O. F. Müller)

Polyscelis variabilis GIRARD, 1850, p. 251.

This species has been reported from Maine by Miss Hyman (1938) and was collected by the writer on the coast of Newfoundland during the summer of 1938.

Genus LEPTOPLANA Ehrenberg

LEPTOPLANA ANGUSTA Verrill

Leptoplana angusta Verrill, 1893, p. 105.

An excellent specimen of this species is in the collection of the United States National Museum (no. 134562). Preserved and mount-

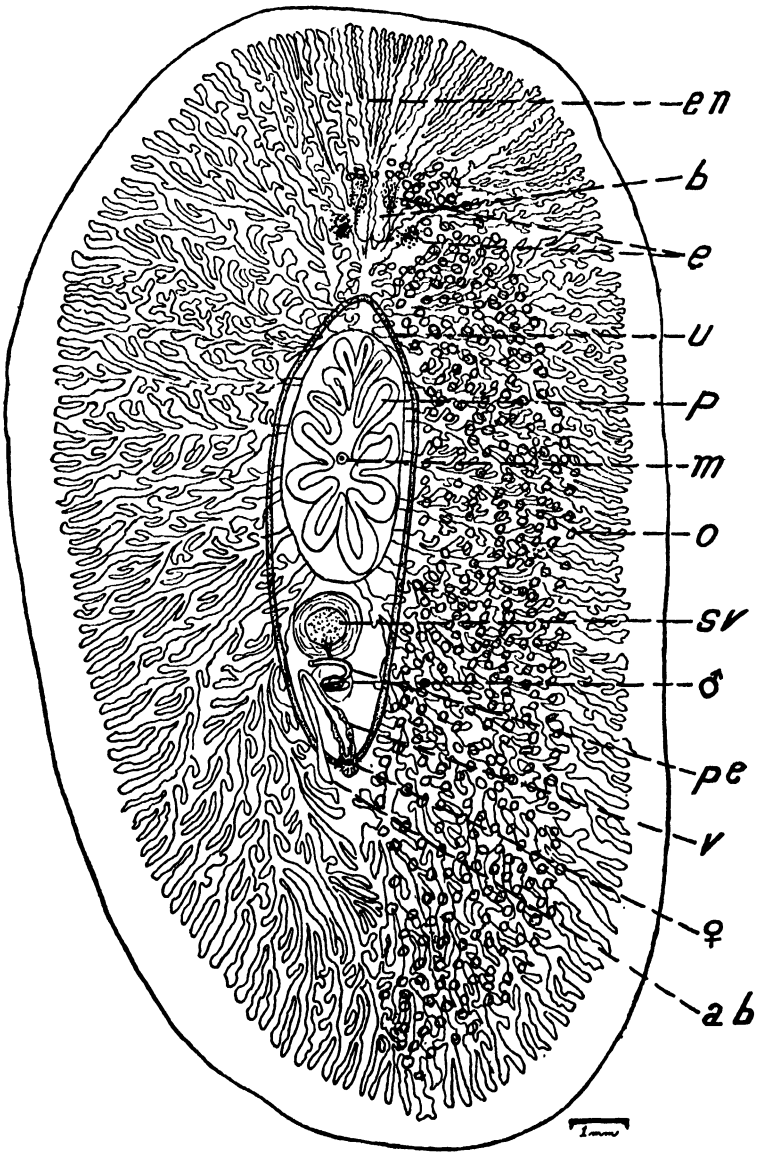


FIGURE 26.—*Leptoplana angusta* Verrill. *ab*, Accessory bladder; *b*, brain; *e*, eyes; *en*, enteron; *m*, mouth; *o*, ovary; *p*, pharynx; *pe*, penis; *sv*, seminal vesicle; *u*, uterus; *v*, vagina; ♂, male opening; ♀, female opening.

ed, it measured 22.5 by 12.7 mm. It was collected near Cobourg Island, Baffin Bay, August 13, 1935, by Capt. Robert A. Bartlett. A specimen found among ascidians on piles in St. Joe Bay, Fla., on March 28, 1936, measured 26 by 6 mm when alive and crawling; preserved and mounted, it measures 13.8 by 5.3 mm. Four other specimens were taken in this locality. I collected one specimen at Beaufort, N. C., during the summer of 1938.

Genus STYLOCHOPLANA Stimpson

STYLOCHOPLANA FLORIDANA, new species

FIGURE 27

Many specimens of this polyclad were collected; two on November 21, 1935, and others in February and March 1936 in old shells from Crooked Island Sound and St. Joe Bay, Fla. When alive these were active and moved about, often making quick jerks of their margins. When disturbed on the surface film they quickly darted to the bottom of the dish, like a wriggling fish. They had a delicate greenish tint. Many individuals appeared to be immature, as there were no eggs in the uteri, but in March some individuals laid eggs in the laboratory, and some of this group measured 8 by 3 mm when crawling and extended. Preserved, stained, and mounted the largest individual measures 6.4 mm long and 2.6 mm wide. The blunt, rounded anterior end in front of the brain is the widest part of the body; the posterior end tapers to a point. Various organs are the following distances from the anterior end: Brain, 1.3–1.6 mm; tentacles, 1.4–1.6 mm; pharynx, 2.0–3.5 mm; mouth, 3.1 mm; seminal vesicle, 3.6 mm; genital opening, 4.2 mm; accessory bladder at posterior end of vagina, 4.3 mm. The pharynx is narrow (0.6 mm) and arranged in about 10 folds on each side. The lateral enteric caeca do not appear to anastomose. There are five or six pairs, and a median anterior caecum. The gut of one of the specimens collected contains a small polychaete worm, and another had eaten the posterior portion of a copepod. An individual examined alive on February 10, 1936, spit out some encysted protozoans, which contained red pigment spots and looked like euglenoids. The tentacles are about 0.1 mm long and bear five or six eyes. Six eyes lie on each side anterior and lateral to the brain and five on each side between and posterior to the bases of the tenacles.

The globular seminal vesicle lies close to the posterior border of the pharynx. It connects with a long (0.3 mm) tube that bears prostate glands and leads to the penis, just anterior to the genital opening. The vasa deferentia are to be seen coiled on each side at the posterior end of the pharynx for a longitudinal distance of about 1.5 mm.

The vagina opens into a short shell gland and is connected by a sinuous course with a small, globular accessory vesicle. The uteri curve around the pharynx on each side from the vagina and unite in front of the pharynx.

Type.—U.S.N.M. no. 20190; from Crooked Island Sound, Farmdale, Fla.; collected November 21, 1935, by A. S. Pearse.

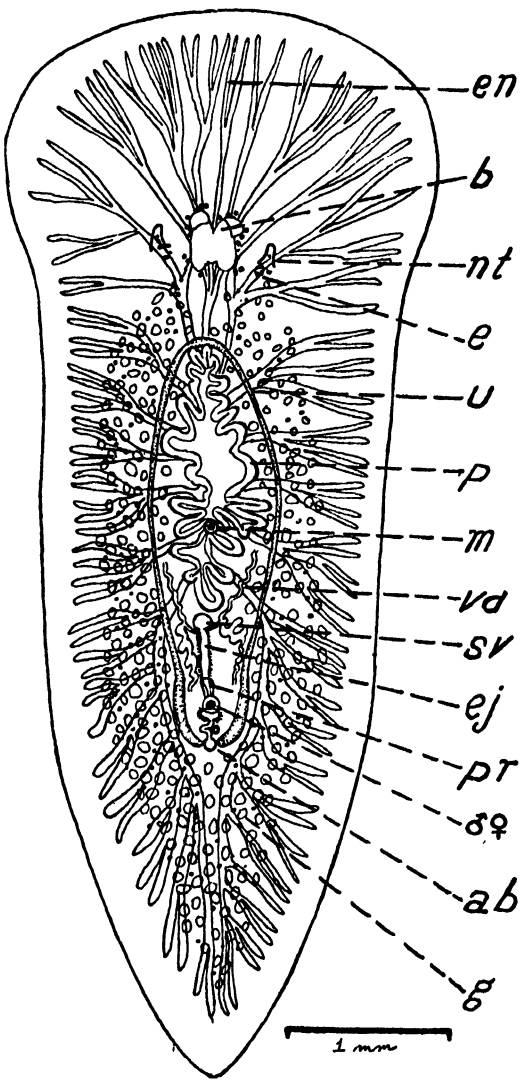


FIGURE 27.—*Stylochoplana floridana*, new species. *ab*, Accessory bladder; *b*, brain; *e*, eyes; *ej*, ejaculatory duct; *en*, enteron; *g*, gonads; *m*, mouth; *nt*, nuchal tentacles; *p*, pharynx; *pr*, prostate gland; *sv*, seminal vesicle; *u*, uterus; *vd*, vas deferens; ♂, male opening; ♀, female opening.

Genus HOPLOPLANA Laidlaw

HOPLOPLANA INQUILINA (Wheeler)

Planocera inquilina WHEELER, 1894, p. 196.

Several specimens were obtained from Woods Hole, Mass., and have been added to the National Museum collections. This polyclad lives in the shells of the large snail *Busycon*.

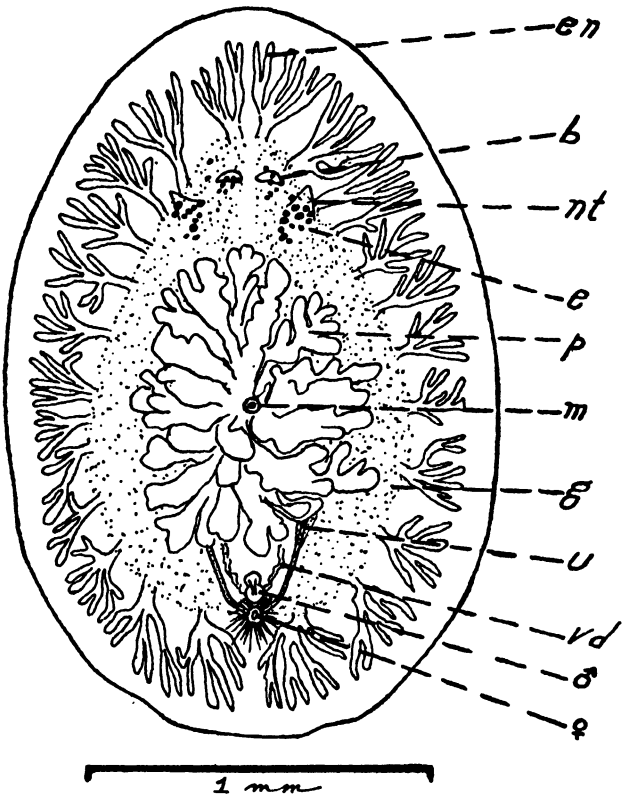


FIGURE 28.—*Hoploplana thaisana*, new species. *b*, Brain; *e*, eyes; *en*, enteron; *g*, gonads; *m*, mouth; *nt*, nuchal tubercles; *p*, pharynx; *u*, uterus; *vd*, vas deferens; ♂, male opening; ♀, female opening.

HOPLOPLANA THAISANA, new species

FIGURE 28

Body flat and short; in preserved specimens about two-thirds as wide as long (3.0 by 2.1; 2.4 by 1.5; 2.2 by 1.3, type; 1.6 by 1.3; 1.4 by 0.9; 1.0 by 0.7 mm). Tentacular eyes are almost one-third of length of body from anterior end. The number in six specimens (3.0–1.0 mm) was 36, 52, 26, 28, 40, 20. The number of cerebral eyes in the same animals was 22, 12, 10, 10, 6, 4. The tentacular eyes are usually

arranged more or less in a circle, or in an irregular circular group; not in horseshoe form with the opening directed posteriorly, as is usually the case in *H. inquilina* (Wheeler). The cerebral lobes are at the posterior end of the first quarter of the body.

The enteron has about 12 lateral branches on each side. These are subdivided and extend nearly to the margin of the body of all sides. The mouth is slightly anterior to the center of the body. The pharynx has about six irregular lobes on each side, and the basal trunks of these are comparatively smooth. The genital openings are in the median line about one-fifth of the length of the body from the posterior end. The one for the female system is about 0.1 mm behind that of the male. A pyriform seminal vesicle is present but no separate prostate gland. The penis is armed with a stylet.

Type.—U.S.N.M. no. 20189, from *Thais floridana* Conrad; collected at St. Vincent Bar, Apalachicola Bay, Fla., October 14, 1935, by A. S. Pearse.

Remarks.—This polyclad was usually found on the sides of dishes in which crushed *Thais floridana floridana* Conrad were allowed to stand, but it was once taken from the sides of pails in which oyster shells were standing and once from a dish of barnacles. All specimens examined came from Apalachicola Bay, Fla. These have been compared with specimens of *Hoploplana inquilina* (Wheeler) that came from the shells of *Busycon canaliculatum* Linnaeus at Woods Hole, Mass. The present species differs from the specimens of that in Massachusetts in its smaller size, in the arrangement and number of the eyes, and in the character of the lateral pharyngeal lobes.

Family PLANOCERIDAE

Genus PLANOCERA Blainville

PLANOCERA NEBULOSA Girard

Planocera nebulosa GIRARD, 1854, p. 367.

The only specimens in the collection of the National Museum carrying this species designation are two determined by the late A. E. Verrill. These specimens properly belong to the genus *Eustylochus*, where I have also referred to them (p. 73). As a matter of record and for convenience, I have included Girard's species in the key to the polyclads of our eastern seaboard, p. 96.

Family STYLOCHOCESTIDAE

CONJUGUTERUS, new genus

Body elongated; at least six times as long as wide when extended; without marginal eyes, tentacles, or tentacular eye groups; pharynx

slightly frilled, in anterior half of body; enteron anastomosed in posterior half; uteri united posteriorly; male and female genital apertures separate, at about the posterior end of the middle body fifth.

Type.—Conjuguterus parvus, new species.

CONJUGUTERUS PARVUS, new species

FIGURE 29

Body at least six times as long as wide. The type, examined alive on March 11, 1935, was 5.2 mm long and 0.8 mm wide when extended and crawling; preserved, it measures 1.93 by 0.94 mm; two other preserved specimens measure 2.9 by 1.0 mm and 3.3 by 1.1 mm. A specimen that laid 150 eggs in a dish in the laboratory on January 30, 1936, measures 1.5 by 0.6 mm preserved. A large specimen collected on March 24, 1936, measured 10.3 by 1.9 mm when alive and extended. In the preserved type, structures along the median line measure the following distances from the anterior end: Eyes 0.24–0.38 mm; brain, 0.27–0.38 mm; pharynx, 0.39–0.82 mm; mouth, 0.58 mm; uteri, 0.55–1.23 mm; vasa deferentia, 0.54–1.06 mm; male genital aperture, 1.1 mm; female genital aperture, 1.3 mm. The eyes are arranged in four pairs of groups lateral to the brain, which consists of two elliptical lobes. The mouth, one-third of the body length from the anterior end, is about in the center of the pharynx. There are about 12 pairs of bifid enteric caeca lateral to the pharynx and uteri; behind the transverse connecting loop of the uterus there are about 12 more pairs; about five caeca extend forward dorsal to the eyes and brain. Behind the uterus the enteron consists, besides the marginal caeca, of a median and two lateral trunks, which are connected by about six transverse canals.

The male genital system is directed backward. The small penis is armed with a curved stylet. A pyriform seminal vesicle connects with it as its base and also with a slightly smaller pyriform prostate gland. The vasa deferentia unite anterior to the seminal vesicle; they extend forward on either side of the pharynx to form a V. The pyriform vagina is surrounded by the follicles of shell gland. The uteri lie lateral and dorsal to the vasa deferentia. They are swollen and somewhat twisted in gravid individuals; a transverse loop connects them posterior to the vagina; they taper anteriorly and may be traced forward to about the middle of the pharynx. The body is unpigmented on the ventral side but the dorsum has small gray-brown specks; the enteron and other organs are visible through the integument; hence most specimens appear to be a delicate light brown.

Type.—U.S.N.M. no. 20197, from St. Joe Bay, Fla.; collected March 11, 1936, by A. S. Pearse.

Remarks.—Other specimens were collected in Florida from Apalachicola Bay, March 16, 1936; Crystal River, October 3, 1935; Eau Gallie, January 16, 1936; St. Joe Bay, March 24, 1936. The worms were always found among old shells. During the summer of 1938, one specimen was taken at Beaufort, N. C.; and several were collected at Ellerslie, Prince Edward Island, Canada.

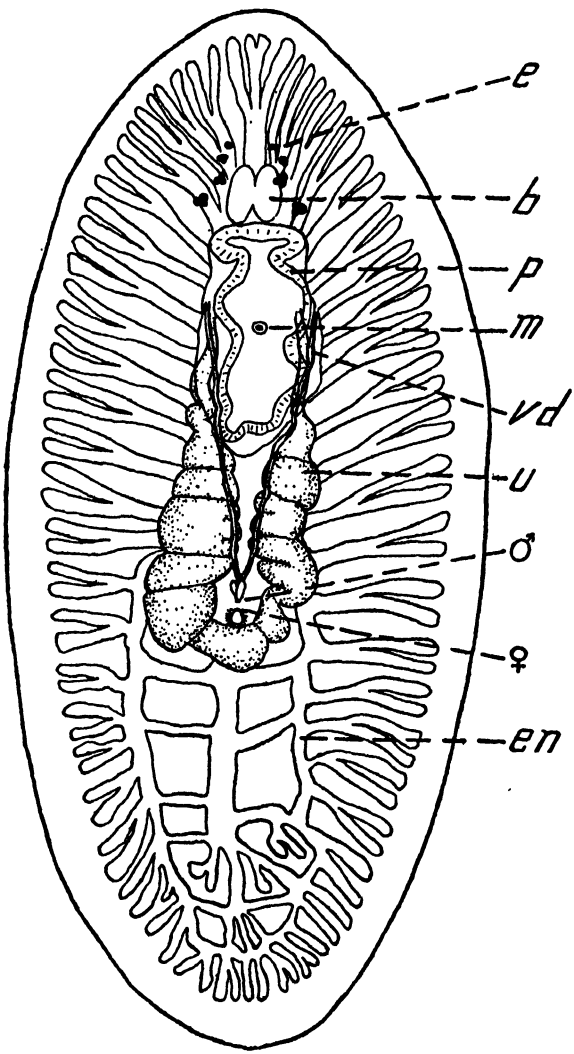


FIGURE 29.—*Conjuguterus parvus*, new genus and species. *b*, Brain; *e*, eyes; *en*, enteron; *m*, mouth; *p*, pharynx; *u*, uterus; *vd*, vas deferens; ♂, male opening; ♀, female opening.

Section EMPROSTHOMMATA

Family CESTOPLANIDAE

OCULOPLANA, new genus

Similar to *Cestoplana*, but with marginal eyes completely around the body. The brain is far back, at least a fifth of the length of the body from the anterior end. A branch of the gut extends forward in the median line dorsal to and between the lateral lobes of the brain to the anterior margin of the body.

OCULOPLANA WHARTONI, new species

FIGURE 30

Body long and slender; in living specimens at least eight times as long as wide when crawling (8 by 1 mm), often longer when extended. In three well-preserved specimens the body is five times as long as wide (11 by 2.1; 8.9 by 1.7; 8.3 by 2 mm, type). The body is blunt and rounded at both ends; the sides are parallel, and the margins are so thin and mobile that they curl readily. At the posterior end there is a weak, poorly defined adhesive organ.

The enteron extends throughout the body. From the median stem about 95 branched lateral twigs and a dozen short blind pouches extend on each side. The median stem extends forward and branches along the anterior margin. The mouth is situated at the anterior end of the posterior fifth of the body. The pharynx at rest is about 0.75 mm long and 0.35 mm wide; two-thirds of it lies behind the mouth.

The brain is in the anterior end of the second fifth of the body. Its total width is about 0.35 mm; the two lateral lobes are 0.1 mm apart. The single female genital aperture is about one-ninth of the length of the body from the posterior end, and the male aperture is about 0.1 mm anterior to it and close to the pharynx. The vasa deferentia and the uteri are to be seen extending forward through a third of the length of the body. Both lie nearly parallel to the median line; the former lie lateral to the latter and are more or less twisted. The penis is unarmed. A pyriform prostate gland is distinct from the siminal vesicle. About 50 small testes lie on either side of the body through about the middle fifth.

Living animals are pale yellowish white, without pigment; the yellowish enteron shows clearly through the integument; some individuals have a delicate pinkish tint.

Type.—U.S.N.M. no. 20195, from St. Vincent Bar, Apalachicola Bay, Fla.; collected August 16, 1935, by George W. Wharton.

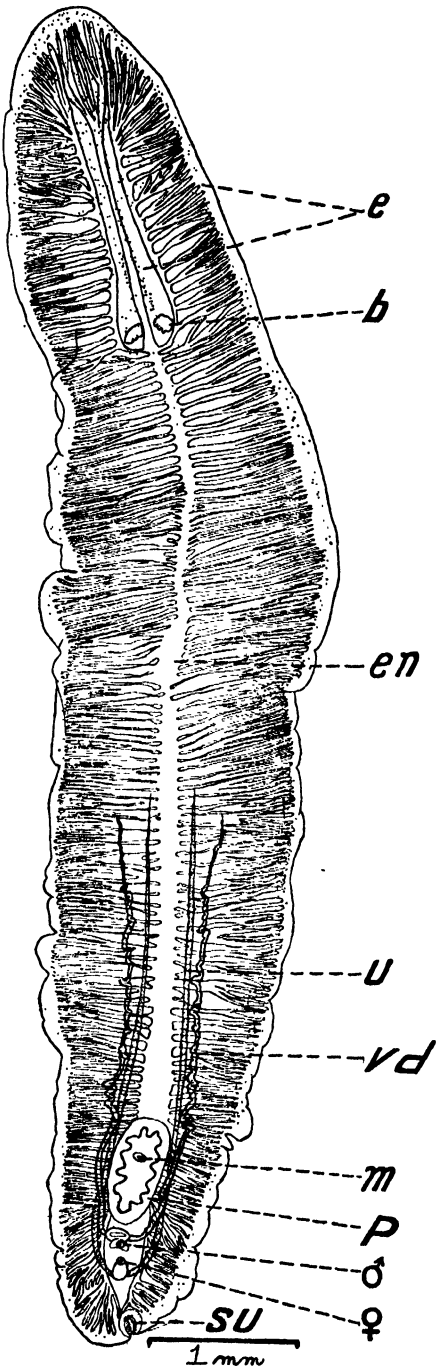


FIGURE 30.—*Ouloplana wharfoni*, new genus and species. *b*, Brain; *e*, eyes; *en*, enteron; *m*, mouth; *p*, pharynx; *u*, uterus; *vd*, vas deferens; ♂, male opening; ♀, female opening.

Remarks.—Specimens have been collected in Apalachicola Bay and near Crystal River, Florida, on shells from oyster bars; June 15 to October 15, 1935. During the summer of 1938 several specimens were taken at Beaufort, N. C.

Suborder COTYLEA

Family PSEUDOCERIDAE

Genus THYSANOZOON Grube

THYSANOZOON BROCCHI (Risso)

Tergipes brochi RISSO, 1818, p. 373.
Thysanozoon brocchi GRUBE, 1840, p. 55.

Four specimens of this papillate polyclad were found among eelgrass at Crooked Island Sound west of Farmdale, Fla., November 21, 1935. When alive and extended they measured 33 by 10, 31 by 10.5, 28 by 12, and 28 by 8 mm. They swam about actively by waving the sides of their bodies. The colors of the four individuals varied somewhat. In one the dorsal papillae were light brown; between them the body was cream color, with a light yellow reticulum, and minute flecks of black pigment grouped so as to form spots; a dark median streak had a light irregular stripe running through it; the region over the brain was unpigmented, but an area about it and extending up onto the marginal tentacles was nearly black. The ventrum was buff, with a median light streak. Two specimens had purplish-brown papillae near the median line, and the color became light brown toward the sides; some of the papillae had white spots and dark tips; there was a white T-shaped area between the purplish marginal tentacles; along the margin there was a brown and purple reticulum, with a tendency to the formation of radial bands. The ventrum was cream color and darker toward the sides. The fourth specimen was intermediate in color between the brown and purple individuals. On February 10, 1936, 11 more specimens of this species were collected in Crooked Island Sound, Fla. They were similar to those previously observed. On March 25 and 26, 1936, 14 specimens were collected in St. Joe Bay, Fla. Some of these laid eggs in dishes in the laboratory.

Genus PSEUDOCEROS Lang

PSEUDOCEROS MACULOSUS, new species

FIGURE 31

The following description is of a single specimen that was first examined alive and later preserved, stained, and mounted. In the

living animal the body was extremely flat; length, 17 mm; width, 7 mm. Tentacles: Length, 1 mm; width, 0.7 mm. Color gray, with a median light dorsal band and a dark border about this, about 135 small dark spots scattered irregularly but evenly over the dorsal surface; ventrum lighter than dorsum but similarly colored, immaculate. The dorsum was roughened by small, low, conical papillae, which were more numerous toward the median line; still smaller papillae occurred between these. The tentacles were folds in the anterior margin and had rounded distal ends. The enteron was reticulate and showed clearly. The animal swam abount by waving its margins but was not so good a swimmer as *Thysanozoon*.

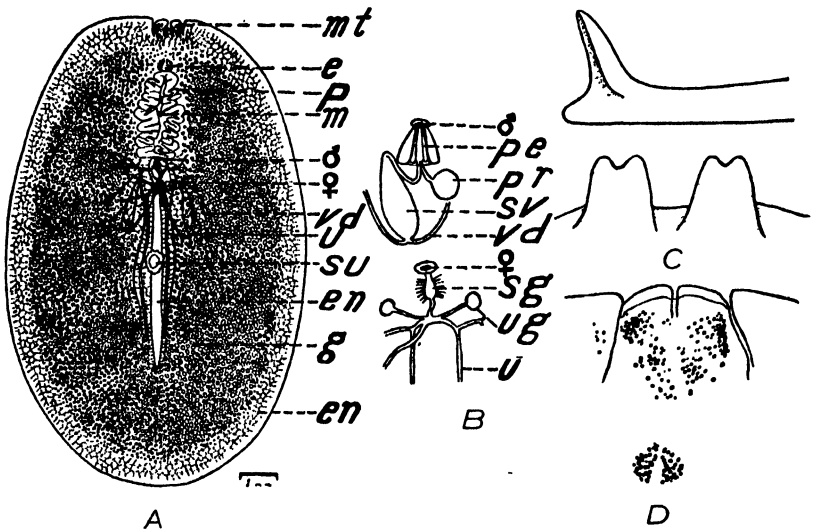


FIGURE 31.—*Pseudoceros maculosus*, new species: *A*, Ventral view of body; *B*, terminal portions of male and female genitalia; *C*, marginal tentacles, lateral and dorsal views; *D*, distribution of tentacular and cerebral eyes. *e*, Eyes; *en*, enteron; *g*, gonads; *m*, mouth; *mt*, marginal tentacles; *p*, pharynx; *pe*, penis; *pr*, prostate gland; *sg*, shell gland; *su*, sucker; *sv*, seminal vesicle; *u*, uterus; *ug*, uterine glands; *vd*, vas deferens; ♂, male opening; ♀, female opening.

Preserved, the body is 13.1 mm long and 8 mm wide. The lobate pharynx is 1.3 mm from the anterior end, 2.7 mm long, and 1.5 mm wide; it has about seven folds on each side. The following figures indicate the distance of various median structures from the anterior end: Mouth, 1.7 mm; male genital opening, 4.2 mm; female genital opening, 4.8 mm; ventral sucker, 7.9 mm; end of median stem of enteron, 9.8 mm. There is a clear margin about 0.4 mm wide in which the reproductive organs are absent, and the branches of the enteron are therefore clearly visible all around the margin of the body. The ventral sucker is 0.6 mm in diameter; the muscular

border around it is 0.15 mm wide, and the aperture is 0.3 mm wide; the margin is wavy. The lateral canals of the enteron are reticulate, and about 42 pairs of lateral branches enter the median stem posterior to the pharynx. Small enteric twigs extend close to the margin of the body everywhere, and some are distributed to the tentacles.

The tentacles are blunt and flat. When extended in a living animal they have vertical grooves on their anterior surfaces. The eyes are arranged in two pairs of lateral groups. An elongated group of about 60 are found within and at the base of each tentacle. The two crescentic cerebral groups each contain 28 eyes. These lie anterior to the pharynx.

The male genital opening is at the posterior border of the pharynx. A conical penis, surrounded by a sheath, lies just inside it. This is connected by ducts with a spherical prostate gland and a long, pyriform seminal vesicle, which extends posteriorly to the female genital opening. The vasa deferentia enter the posterior end of the vesicle from each side. They have four branches on each side. These connect with the numerous testes, which lie in the lateral areas and extend across the body posterior to the median enteric stem. The female genital opening leads into an antrum and a shell gland. Posterior to this is a short slender duct that divides into two branches on the left side and three on the right. The anterior branches on each side lead to small uterine glands; the other branches extend posteriorly on each side of the body. The numerous ovaries are interspersed with the testes in the lateral and posterior areas.

Type.—U.S.N.M. no. 20191, from Crooked Island Sound, Farmdale, Fla., collected November 21, 1935, by A. S. Pearse.

Remarks.—This species is distinguished from others in the genus *Pseudoceros* by its maculate, papillate dorsum and the arrangement of the female genital ducts.

Family EURYLEPTIDAE

Genus EURYLEPTA Ehrenberg

EURYLEPTA MACULOSA Verrill

Eurylepta maculosa Verrill, 1893, p. 495.

Verrill's type and two cotypes are in the National Museum, but they are poorly preserved and, even stained and mounted, show very little.

OLIGOCLADO, new genus

Like *Oligocladus* Lang, 1884, but the mouth is not in front of the brain and the male genital aperture is near the posterior margin of the pharynx. The body is flat and elliptical. There is a pair of

slender conical tentacles at the anterior end, with eyes between the bases and in the basal halves of the tentacles. Two groups of cerebral eyes lie on each side and connect across the anterior margin of the brain. The median stem of the enteron connects with three pairs of lateral branches. At its posterior end there is an anus. The uteri lie lateral to the median enteron, and outside (lateral to) them are two slender ducts, which connect a glandular organ at the anterior end of the uteri with the anus. Lateral to these ducts are the coiled vasa deferentia, which fuse behind the anus and extend beyond as a short loop.

Type.—Oligoclado floridanus, new species.

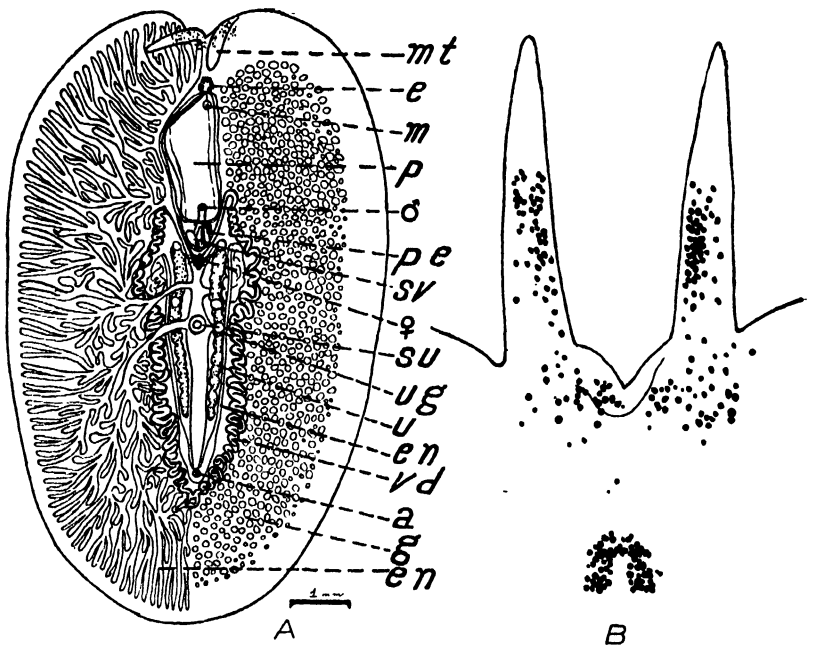


FIGURE 32.—*Oligoclado floridanus*, new genus and species: *A*, Ventral view, enteron on left, gonads on right; *B*, anterior end showing eyes and tentacles. *a*, Anus; *e*, eyes; *en*, enteron; *g*, gonads; *m*, mouth; *mt*, marginal tentacle; *p*, pharynx, *pe*, penis; *su*, sucker; *sv*, seminal vesicle; *u*, uterus; *ug*, uterine gland; *vd*, vas deferens; ♂, male opening; ♀, female opening.

OLIGOCLADO FLORIDANUS, new species

FIGURE 32

A single specimen was collected. When alive and crawling and extended it measured 18 mm long and 8 mm wide. The tentacles at the anterior end were slender and acute and bore eyes in their proximal half. The color of the dorsum was brown, with a purplish me-

dian band and a cream-colored margin. The brown color appeared to be due largely to the enteron. The ventrum was light brown, with a light band through the middle two-thirds of the body, probably due to the genitalia.

The specimen preserved, stained, and mounted is 12.8 mm long and 8.0 mm wide. Organs in the median line are the following distances from the anterior end: Brain, 1.5 mm; pharynx, 1.75–4.4 mm; mouth, 2.0 mm; male genital opening, 4.2 mm; female genital opening, 5.2 mm; ventral sucker, 6.7 mm; median enteric stem, 5.5–9.9 mm; anus, 9.8 mm. The tentacles are 1.3 mm long, slender, and tapering. About 80 eyes are at and between their bases; about 50 eyes occupy the proximal half of each tentacle; about 70 cerebral eyes are arranged in the form of a horseshoe, with the opening posterior.

The tubular pharynx lies immediately behind the brain. From it the median enteric stem extends to the anus. Three pairs of lateral, branched caeca leave the stem in its anterior half and extend to all margins of the body. On each side of the anus two tubes extend forward to the anterior ends of the uteri and there connect with the anterior ends of what appear to be two lateral glandular organs, which measure about 1.3 by 0.4 mm.

The male genital system opens on the ventral side of the body at the anterior margin of the posterior ninth of the pharynx. A conical antrum leads to a slender penis, which bears a spine and is enclosed in a sheath. Connected with the penis are two organs: A small spherical prostate gland and an elongated, pyriform seminal vesicle. The vasa deferentia extend forward on either side of the pharynx for a short distance and then coil backward and fuse behind the anus. They extend posteriorly beyond their point of fusion to form a small loop and a blind appendage. Numerous small testes are distributed all round the body, except for a band (0.75 mm wide) about the margin and in the median space occupied by enteric and genital organs. The slightly larger ovaries have about the same distribution. The cylindrical uteri extend longitudinally on each side of the median enteric stem; length, 3.7 mm; width, 0.3 mm. The ventral sucker is between their middles. There appear to be three pairs of globular uterine glands on their anterior halves. Two ducts lead from their anterior ends to the shell gland and the ventral genital pore.

Type.—U.S.N.M. no. 20192, from Crooked Island Sound, Farmdale, Fla.; collected November 21, 1935, by A. S. Pearse.

During the summer of 1938 several specimens of this species were found at Beaufort, N. C.

Genus ACEROTISA Strand

ACEROTISA PELLUCIDA, new species

FIGURE 33

Body flat, delicate and elliptical in outline; size of two preserved specimens: 7.1 by 4.3; 5.7 by 3.8 mm. The median ventral sucker is at the posterior end of the anterior third of the body; diameter, 0.2 mm. The cerebral eyes in the two specimens number 34 and 24, respectively. They are arranged in two irregular, elongated groups anterior and posterior to the brain lobes on each side. There are about 12 small eyes along the anterior margin; two near the median line; three lateral to these in a longitudinal series; and two farther toward the sides. The brain lies at the posterior end of the anterior ninth of the body. A reticulate nervous system is easily seen all around the margin and is especially clear at the anterior end. The mouth is immediately behind the brain, about 1.0 mm from the anterior end. The pharynx is tubular, 0.7 mm long and 0.5 mm wide.

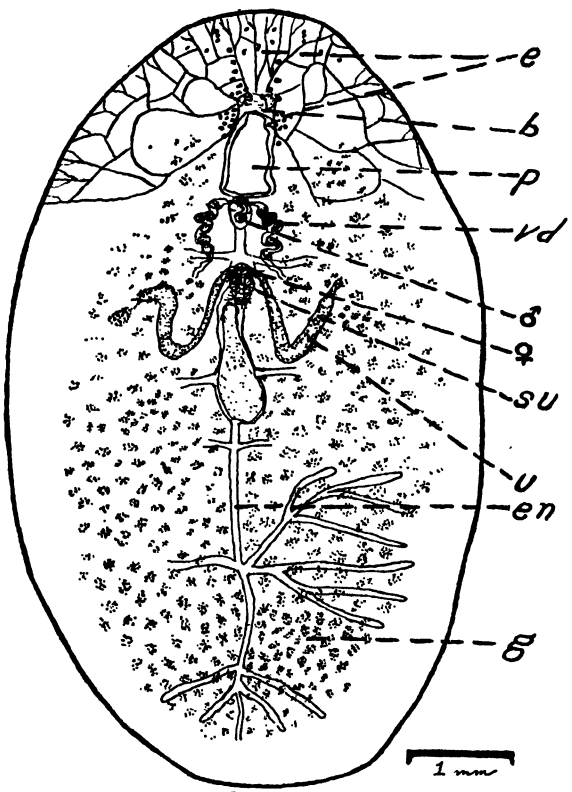


FIGURE 33.—*Acerotisa pellucida*, new species: Dorsal view. *b*, Brain; *e*, eyes; *en*, enteron; *g*, gonads; *p*, pharynx; *su*, sucker; *u*, uterus; *vd*, vas deferens; ♂, male opening; ♀, female opening.

The median stem of the enteron is readily seen extending from the pharynx to near the posterior end of the body, but the twigs of the four pairs of lateral branches cannot be made out well in the preserved specimens available.

The male genital aperture is close to the posterior margin of the pharynx. The coiled vasa deferentia enter the male bursa near its anterior end and may be seen to extend posteriorly about 0.8 mm on either side. Oval testes about 0.05 mm long are scattered evenly through the interior of the body from the pharynx posteriorly, except in a zone about 0.5 mm wide about the margin. A prostate gland is separate from the seminal vesicle. The female genital pore is about 0.6 mm posterior to that of the male system. It is connected with two uteri, which bend posteriorly and then anteriorly.

Type.—U.S.N.M. no. 20193, from St. Vincent Bar, Apalachicola Bay, Fla.; collected June 25, 1935, by A. S. Pearse.

Remarks.—Only two specimens of this species were collected. These were pale, pellucid and had no pigment or distinctive color, the body appearing whitish.

Family PROSTHIOSTOMIDAE

Genus PROSTHIOSTOMUM Quatrefages

PROSTHIOSTOMUM LOBATUM, new species

FIGURE 34

Body of living specimen slender; head rounded and wider than body, which tapers toward the pointed posterior end; three specimens studied alive on December 2, 1935, measured 17 by 2.7, 11 by 2.3, and 7 by 1 mm. Three preserved specimens show the following distances (in millimeters) from the anterior end to various organs and openings:

Size	Brain	Mouth	Male opening	Female opening	Sucker
10.8 by 3.5	1.1	1.7	5.1	5.6	6.4
5.9 by 1.8	0.3	1.3	3.6	3.8	4.1
5.3 by 1.8	0.3	0.4	2.7	2.9	3.3

The last line shows that when the body is strongly contracted the mouth may be brought in close proximity with the brain. The sucker is often lobate in contracted specimens, as the figure shows. This feature is used to give the specific name to the species.

The eyes number about 106 in adult worms, but younger specimens have been examined with 4, 12, 20, 22, 28, 40, 58, and 70. In three favorable large specimens the number of eyes is as follows:

Size	Cerebral	Intermediate	Marginal	Total
Mm				
10.8 by 3.5	35	0	70	105
5.9 by 1.8	34	2	70	106
5.3 by 1.8	17	2	51	70

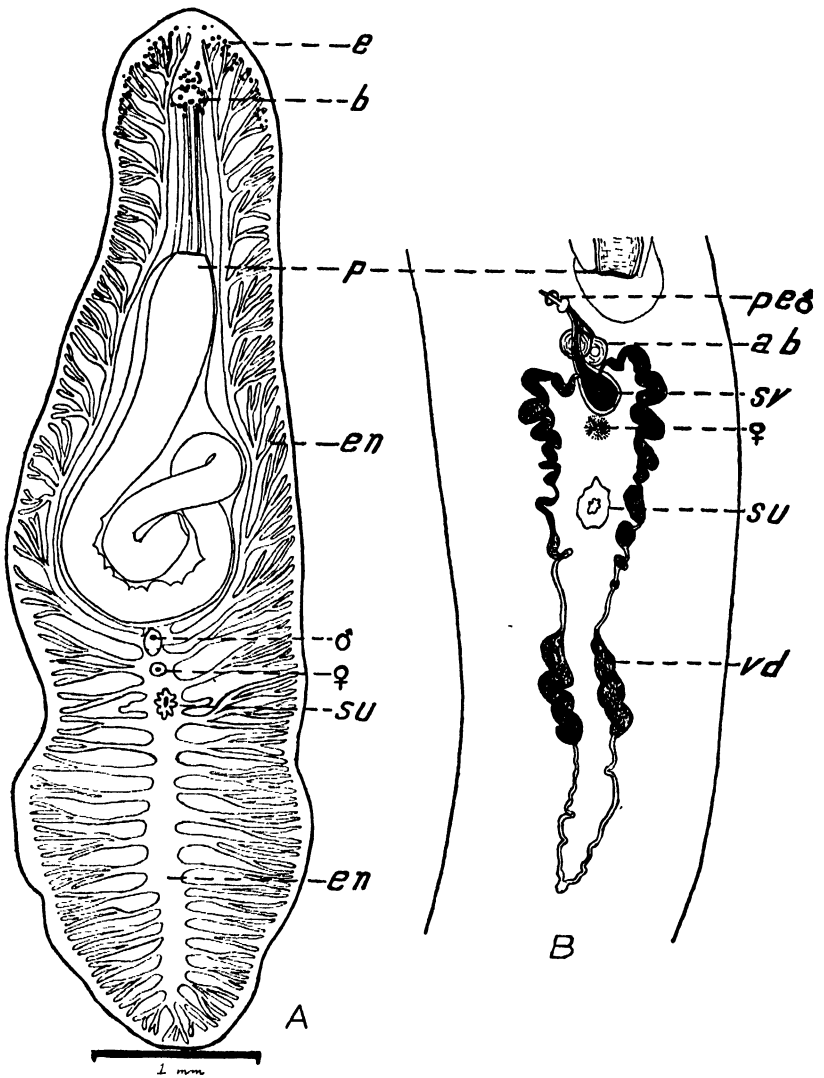


FIGURE 34.—*Prothiostomum lobatum*, new species: *A*, Ventral view of body; *B*, ventral view of middle of body. *ab*, Accessory bladder; *b*, brain; *c*, eyes; *en*, enteron; *p*, pharynx; *pe*, penis; *su*, sucker; *sv*, seminal vesicle; *vd*, vas deferens; ♂, male opening; ♀, female opening.

There are no marginal eyes at the anterior end for a space of about 0.15 mm wide; on each side of this a group of about 35 eyes extends along the margin, about two-thirds of the eyes being anterior to the brain. The cerebral eyes are usually arranged in the form of a horseshoe or a V, with the opening directed posteriorly. They lie dorsal to the brain and extend in front of and behind it.

The enteron consists of a median stem and about 22 lateral branches on each side. The twigs of these extend to near the margin throughout the body. The pharynx is often coiled within its sheath or may even be thrown out of the body in preserved specimens, but in living worms it rests longitudinally and in moving specimens is indicated by a median ridge near the anterior end. In it longitudinal muscles lie within the circular muscles.

About 300 small rounded testes may be seen interspersed among the lateral twigs of the enteron. They extend forward on either side to just posterior to the brain. The male genital pore lies immediately behind the pharynx. Two vasa deferentia enter the genital bursa near the posterior end from the sides and bend sharply to extend backward at right angles along each side of the median stem of the enteron. The female genital opening is close behind the male opening about 0.2 to 0.3 mm distant. The uteri coil along the sides and extend almost to the posterior end of the body. The ovaries are diffuse lobate structures on either side of the median enteric stem forward as far as the anterior third of the pharynx. The genital organs do not occur along the margins of the body; a zone about 0.3 mm wide is thus left free.

Color, unpigmented except for the eyes. Living specimens are cream color or dirty white, and darker yellowish-brown toward the median line because the internal organs show through the integument.

Type.—U.S.N.M. no. 20194; from St. Vincent Bar, Apalachicola Bay, Fla.; collected August 16, 1935, by A. S. Pearse.

Remarks.—This species was not uncommon in Apalachicola Bay during 1935–36. It was usually found at the surface of pails of shells that had been brought in from the oyster bars and allowed to stand. Several large specimens were collected in St. Joe Bay, Fla., March 24, 25, 1936. Some of them laid eggs in the laboratory. The two largest measured 22 by 3 and 24 by 3.3 mm when extended and crawling A young specimen was collected near Crystal River, Fla., on October 3, 1935. During the summer of 1938 specimens were collected at Beaufort, N. C. The species differs from *Prosthiostomum gracile* Girard, 1850, in its larger size and in the arrangement of the eyes.

KEY TO POLYCLADS REPORTED FROM THE EASTERN COAST OF NORTH AMERICA

1 (40). Without ventral sucker or marginal tentacles--- suborder **Acotylea**, 2

2 (21). With marginal eyes; male genital organs directed posteriorly, no cirrus; nuchal tentacles present or absent; uteri never fuse anterior to pharynx---- section **Craspedommata**, 3

3 (6). Nuchal tentacles absent (or rudimentary); pharynx long, central, frilled; 1 or 2 genital openings close to pharynx, and not near posterior end; large muscular penis; no vagina bulbosa---------- family **Discocelidae**, 4

4 (5). Color gray, with radiating light streaks and a lighter median band; cerebral and tentacular eyes in 2 pairs of groups; Florida, North Carolina----**Discocelis grisea**, new species

5 (4). Color yellowish brown, with or without darker median band; cerebral and tentacular eyes tend to form 3 pairs of groups; Connecticut, Massachusetts. **Discocelis mutabilis** (Verrill, 1873)

6 (3). Nuchal tentacles present---------- 7

7 (10). With 3 genital openings; penis unarmed and without sheath; nervous system reddish in life------ family **Latocestidae**, 8

8 (9). Size large, 20–25 mm by 10–15 mm; color yellowish, pale over pharynx; Rhode Island, Massachusetts. **Trigonoporus folium** (Verrill, 1873)

9 (8). Size small, 12–15 mm by 6–8 mm; color yellowish or pinkish; Cape Cod, 25 fathoms--- **Trigonoporus dendriticus** Verrill, 1893

10 (7). With 2 genital openings; body broad or slender oval, firm; eyes around all or part of margin; tentacular and cerebral eye groups present but sometimes diffuse; nuchal tentacles large, small (or absent in non-American species); pharynx central and frilled; male genital system directed posteriorly; prostate gland, separate; ejaculatory duct opens into prostate duct or separately; no vagina bulbosa---------- family **Stylochidae**
Female genital opening near posterior end and near that of male; female system without Lang's vesicle, genito-intestinal vesicle, or vaginal duct; nuchal tentacles present---------- subfamily **Stylochinae**, 11

11 (12). With 2 clearly separate genital openings at least a seventh of body length from posterior end---------- genus **Stylochus**, 13

12 (11). With genital openings very close together and less than a twentieth of body length from posterior end. genus **Eustylochus**, 19

13 (14). Body when extended 30–40 mm long and 10–12 mm wide, rounded at ends; pharynx mostly anterior to middle, mouth at end of anterior third; color yellowish brown, with numerous transverse light stripes, sometimes with a light median band; usually in *Busycon* shells; New England, North Carolina----------**Stylochus zebra** Verrill, 1882

14 (13). Body when extended not more than three times as long as wide; mouth and pharynx near middle; not transversely striped---------- 15

15 (16). Color yellowish gray, with brown spots at margin; tentacles small obtuse; pharynx with 5 pairs of lateral branches; Massachusetts, [? South Carolina].
Stylochus frontalis Verrill, 1893

16 (15). Color pink or gray; tentacles acute; pharynx with more than 5 pairs of lateral branches ---- 17

17 (18). Body large, 53 by 27 mm; color pink with small oval flecks on a creamy background; Apalachicola Bay, Fla.
Stylochus floridanus, new species

18 (17). Body usually of medium size, 48 by 28 mm; color gray; east and west coasts of Florida ---- Stylochus inimicus Palombi, 1931

19 (20). Body slender, 20 by 6 mm; brain and cerebral eyes in front of nuchal tentacles; color yellowish brown or reddish, pattern reticulate; New England.
Eustylochus ellipticus (Girard, 1850)

20 (19). Body little more than twice as long as wide when extended, 24 by 11 mm; brain and cerebral eyes behind and between nuchal tentacles; color reddish or sometimes gray, pattern not reticulate; Maryland to Texas.
Eustylochus meridianalis, new species

21 (2). Without marginal eyes, or with body ribbonlike and eyes around whole margin; body more or less delicate ---- 22

22 (39). No marginal eyes, and eyes that are present far from front; male genitalia directed posteriorly; body not ribbonlike ---- section Schematommata, 23

23 (36). Body somewhat elongated; without or with nuchal tentacles; prostate gland separate when present; penis with or without stylet; *uteri united anterior to pharynx.*
family Leptoplanidae, 26

24 (29). No tentacles; body elongated, elliptical in outline; margin more or less folded ---- genus Leptoplana, 25

25 (26). With about 12 pairs of lateral pharyngeal lobes; color light brown with darker median streak; length 12–16 mm by 4–6 mm; Massachusetts, Baffin Bay, North Carolina, Florida ---- Leptoplana angusta Verrill, 1893

26 (25). With 6 or fewer paired pharyngeal lobes ---- 27

27 (28). Mouth anterior to middle of pharynx; color pale brown, with darker flecks; size 18 by 10 mm; Cape Cod, 13.5 to 31 fathoms ---- Leptoplana virilis Verrill, 1893

28 (27). Mouth about in middle of pharynx; color variable, yellowish brown, salmon, greenish; Massachusetts, Maine, Newfoundland; 0 to 42 fathoms.
genus Notoplana, N. atomata (O. F. Müller, 1776)

29 (24). With nuchal tentacles ---- 30

30 (33). Body elliptical with rather pointed ends; in gastropods.
genus Hoploplana, 31

31 (32). Lateral pouches of pharynx with smooth basal trunks; cerebral eyes usually arranged in an irregular circle; size 3.0 by 2.1 mm; in *Thais;* Florida.
Hoploplana thaisana, new species

32 (31). Lateral pouches of pharynx saccate to base; cerebral eyes usually arranged in shape of a horseshoe with a posterolateral opening; size 6 by 4 mm; in *Busycon;* Massachusetts ---- Hoploplana inquilina (Wheeler, 1894)

33 (30). Anterior end of body wide, tapering to a point posteriorly; very active, often swimming_____ genus **Stylochoplana**, 84

34 (36). Color bright red, with light margins on which are pale yellow spots; size, 38 by 6 mm; Massachusetts.

Stylochoplana oculifera (Girard, 1854)

35 (35). Unpigmented with a delicate greenish tint; size 8 by 3 mm; Florida, North Carolina.

Stylochoplana floridana, new species

36 (23). Uteri not united anterior to pharynx_____ 38

37 (38). Body when extended six times as long as wide; mouth and pharynx in anterior half of body; Florida, North Carolina, Prince Edward Island.

family **Stylochocestidae**, **Conjuguterus parvus**, new genus and species.

38 (37). Body round-oval; with prostate gland separate from vesicular duct; genital pores not close to posterior end; mouth and pharynx central_____ family **Planoceridae**

Body 29 by 10 mm; color olive-green, with median dorsal stripes; South Carolina to Massachusetts.

Planocera nebulosa Girard, 1854

39 (22) With or without marginal eyes[2]; body ribbonlike, delicate; pharynx and male genitalia near posterior end and the latter directed forward_____ section **Emprosthommata**

No nuchal tentacles; eyes in genus *Cestoplana* do not occur on margin, but in the present new genus *Oculoplana* they completely surround the body; Florida, North Carolina.

family **Cestoplanidae**, **Oculoplana whartoni**, new genus and species

40 (1). With a sucker behind the genital pores; often with marginal tentacles; pharynx frilled, folded, or tubular.

suborder **Cotylea**, 41

41 (44). Usually large, often brightly colored, oval, rough or smooth; with foldlike marginal tentacles; mouth in middle of front half of body; pharynx folded; enteron reticulate; sucker in middle of body; vasa deferentia and uteri branched; eyes in double cerebral groups and anterior and posterior to tentacles_____ family **Pseudoceridae**, 42

42 (43). Dorsum covered with long fingerlike papillae; Florida.

Thysanozoon brocchi (Risso, 1818)

43 (42). Dorsum not covered with long papillae; Florida.

Pseudoceros maculosus, new species

44 (41). Marginal tentacles if present not foldlike, but slender and conical or absent; pharynx tubular_____ 45

45 (50). Body oval or elliptical in shape_____ family **Euryleptidae**, 46

46 (47). Without anterior tentacles; enteric caeca few and little branched; Florida_____ **Acerotisa pellucida**, new species

47 (46). With 2 slender anterior marginal tentacles_____ 48

48 (49). Median stem of enteron with anus at posterior end; body 18 by 8 mm; brown, with median purplish band; Florida, North Carolina.

Oligoclado floridanus, new genus and species

[2] The presence of eyes around the entire body in the genus *Oculoplana* makes a revision of Bresslau's Emprosthommata necessary.

49 (48). Without anus; 15 by 10 mm; yellow, with brown spots; New England---------- **Eurylepta maculosa** Verrill, 1893

50 (45). Body elongated, ribbonlike, and delicate; without tentacles; eyes along anterior margin and over brain; pharynx tubular; mouth behind brain_ family **Prosthiostomidae**, 51

51 (52). Body 4 by 1.25 mm; marginal eyes continuous across front; tentacular, cerebral, and frontal eyes in 4 groups; New England---------- **Prosthiostomum gracile** Girard, 1850

52 (51). Body 17 by 2.7 mm; eyes in 2 lateral marginal groups; with a space between them at anterior end, and an irregular cerebral group; Florida.

Prosthiostomum lobatum, new species

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HOPEWELLIAN REMAINS NEAR KANSAS CITY, MISSOURI

By WALDO R. WEDEL

EARLY in February 1937, the Bureau of American Ethnology was notified of an Indian village site in Platte County, Mo., about 5 miles northwest of Kansas City. The information was shortly communicated to me, since at the time I was formulating plans for field work in nearby northeastern Kansas as the initial step in a projected State-wide archeological survey. According to the correspondent, J. M. Shippee, of North Kansas City, the site was located on Line Creek, a small formerly perennial stream falling into the Missouri from the north about midway between Kansas City and Parkville. Though long known to local collectors of surface relics, its possibilities were not realized until recent pipe-line and highway construction had revealed cultural material to a depth of 2 feet or more. Aside from the fact that no village sites in this locality had ever been systematically excavated and described, it was also noted that on the wooded bluffs just east of the village were located the Brenner, Klamm, and Keller mound groups. Excavated many years ago and described by Fowke and others,[1] some of these mounds have been found to contain stone-walled burial chambers, but their cultural identity has never been established. Upon request, sketches and descriptions of the pottery fragments and other remains on the nearby village site were furnished us, and it was at once suspected that the complex represented therein was

[1] Fowke, Gerard, Antiquities of central and southeastern Missouri. Bur. Amer. Ethnol. Bull. 37, pp. 65–73 and references, 1910.

very unlike any heretofore described from the Plains or the Missouri Valley.

This suspicion was confirmed in May 1937, when I proceeded to Kansas City and made a personal examination of the remains in company with Mr. Shippee. It was found that the most promising undestroyed portions of the site were occupied by the owner's residence, garage, poultry yard, and garden. Permission to excavate was nevertheless unhesitatingly granted by the owners, Mr. and Mrs. Leslie Renner, who had previously and have since protected the site against vandalism, besides extending to us at all times the utmost courtesy and cooperation despite the inconvenience to which they were put. Investigations, in which I was assisted by four students, subsequently covered the entire month of June. Through the good services of Ralph Henneman, another interested collector, and the kindness of Transcontinental Western Air and United States Bureau of Air Commerce officials, we were enabled to supplement our records with an aerial reconnaissance of the site and its surroundings.

The Renner site, so named after the owners, is situated on a small terrace on the right bank of Line Creek about a mile north of the Missouri River. It covers an area of about 5 acres, immediately below the junction of Juntin Branch and Line Creek, just before the latter emerges from the bluffs zone to cross the alluvial river bottoms. Riverside Racetrack is nearby to the south. The bluffs east and west of the site rise to heights of 150 feet or more and are still partially covered with oak, ash, elm, walnut, hickory, and other hardwood species. To the north is the attractive and fertile Line Creek Valley, in which are other old villages as yet unexplored.

The new road, on U. S. Highway 169 between U. S. 71 and Missouri State Highway 45, cut a strip nearly 100 feet wide across the center of the site. In the roadside cross sections there had been revealed a dark soil zone extending from the ground surface to a depth varying from 13 to 30 inches. Below and usually sharply separated from this dark stratum was bright yellow clay subsoil. Numerous potsherds, burnt limestone boulders, animal bones, and flints occurred throughout the upper layer and appeared to be especially plentiful in and near pits that extended to depths as much as 6 feet below the present ground surface. Unquestionably, great quantities of cultural material were destroyed in building the highway, but through courtesy of the superintendent of construction, H. M. Kleifeld, most of what had been rescued was presented to us for the national collections.

Up to the present, no detailed studies of our findings have been made. Since further investigations in the locality are now under consideration, it is likely that the full report will be delayed for some time. Meanwhile, a preliminary notice of the remains may be of interest, especially to those concerned with determining the relationship between early Plains cultures and the archeological complexes found in the Eastern United States. Such generalizations as may be suggested here are subject to revision in the light of more intensive analyses and further field investigations.

Our excavations were confined to the remaining part of the site lying east of the new road, between it and the creek bottoms. Here over an area of about 3,000 square feet the cultural layer was stripped off by troweling until subsoil was reached, at which level the pits showed as dark trash-filled circular spots. Thirty-six of these were opened, averaging about 3 feet in diameter and 2½ to more than 5 feet in depth. Originally these were probably used for storage of foodstuffs, but most of them yielded only refuse and a few artifacts. Noteworthy among their contents, aside from artifact materials, were charred maize, beans, pawpaw seeds, and several species of nuts, as well as quantities of mammal, bird, and fish bones. Bulk of the mammalian remains were apparently of the deer, but there is evidence also of the bison. No postholes, firepits, or other traces of houses were noted, although there were numerous large and small chunks of baked brick-red clay of unknown purpose. It is inferred that the habitations must have been entirely of perishable materials rather than of the substantial earthlodge type used by many tribes and peoples of the Missouri Valley. There is some slight evidence for the former existence of refuse mounds, but mostly the detritus now occurs either in the pits or as admixture in the old living surface of the village.

Potsherds were found in great abundance everywhere on the site. It was at first thought that these represented two distinct types, but more careful scrutiny suggests the presence of intergrading specimens. At one extreme are coarse, thick, gravel-tempered sherds with cord-roughened exteriors. These apparently are from large pointed-base jars, none of which have yet been actually reconstructed. Below the squared lip is usually a row of embossed nodes, punched outward from the interior, and above these may or may not be found the vertical or diagonal imprints of a small cord-wrapped stick or a dentate implement (pl. 3, *G*). Other large similarly shaped vessels, also bearing the bosses but with plain neck and rocker-roughened body decoration, are indicated (pl. 3, *F*, *H*, *I*). The heavy gravel-tempered pointed-base jars, with cord-roughening and punched bosses, are strikingly reminiscent of sherds found at sev-

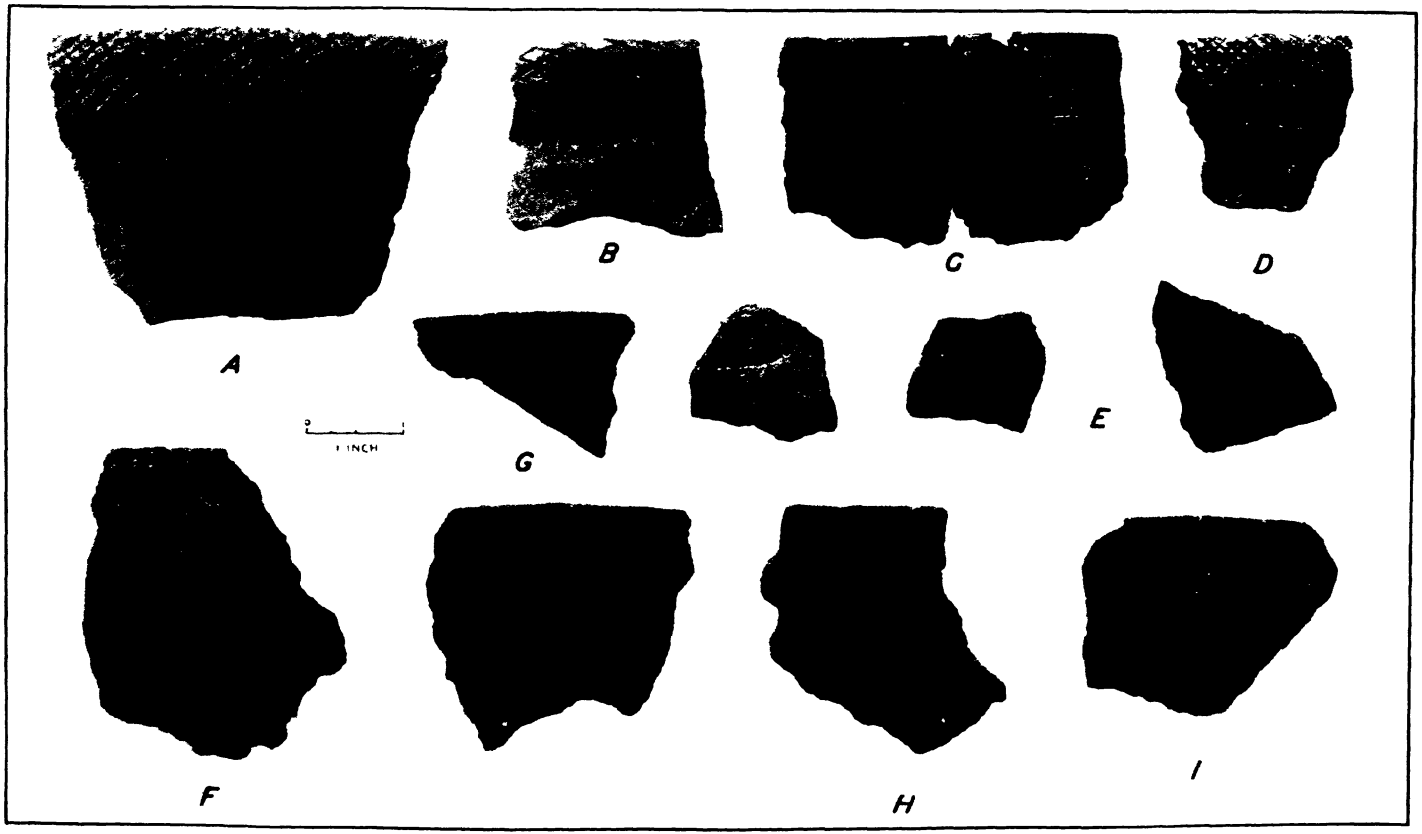
eral deeply buried sites in eastern Nebraska, where they apparently represent the earliest known ceramic horizon.

Greatly superior in quality and decorative technique are many sherds of a type heretofore unrecorded this far west. Here gravel or grit tempering is again universal, but it is more sparingly used and of finer texture. Vessels were small to medium in size (up to 1 or possibly 2 gallons capacity), with thin walls and slightly constricted necks. Rim profiles show a more or less pronounced channel or groove on the inside, an inward-beveled lip, with cross-hatched (or rocker-marked) and punctate decoration on the outer surface (pl. 3, *A–D*). This ornamentation also occurs on some fragments of the larger, rougher jars of the preceding type, where the zones of cross hatching and punctates are occasionally separated by a row of embossed nodes. From the restorable vessels and larger sherds it is evident that the neck in this second type of ware was usually a plain smoothed band, separated by a wide incised line or groove from the ornamented body. Decoration on the body usually consisted of rocker-roughening, sometimes with scroll or other curvilinear designs worked out in alternate smooth and roughened bands separated by narrow to wide shallow grooves (pl. 6, *B*). One incomplete jar was evidently square with rounded corners, each of the latter being rocker-roughened (pl. 5, *H*). A few sherds suggest use of a dentate tool such as the roulette (pl. 3, *E*), but the majority were impressed with a smooth rocker. Many body sherds bear no decoration whatever. In most respects this ware closely approaches the so-called Hopewellian type, but the body ornamentation is somewhat less intricate and the roulette or dentate stamp technique apparently less common than on pottery from the classic sites farther east.[2]

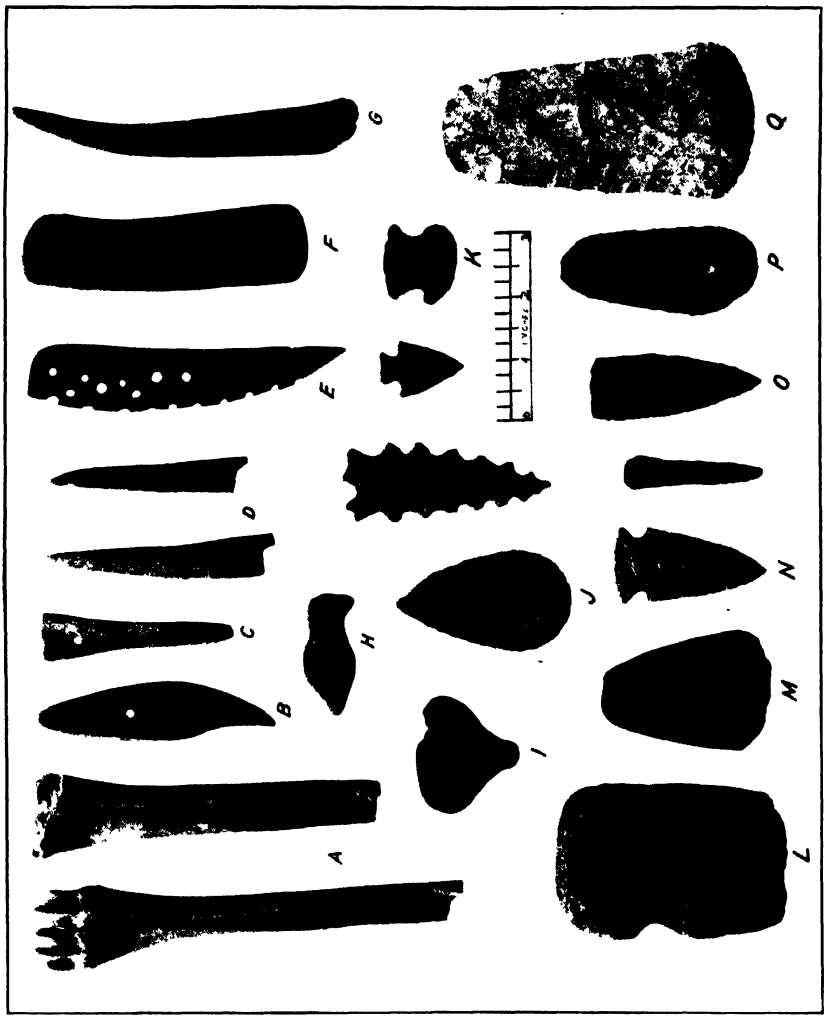
It is possible that detailed counts of the several thousand potsherds recovered will reveal some variation in the relative frequency of the several sherd types at different depths. Such variation, if it exists, is not now apparent, and it was definitely noted that the various types occurred together in a number of the pits as well as side by side throughout the culture stratum.

Of unusual interest is a portion of a smoothed bowl bearing rocker-roughened designs suggestive of a conventionalized hand (pl. 6, *A*). Originally there were apparently four of these decorative units encircling the vessel, each inclosed by a broad incised line. Miniature pottery, including the bowl of a tiny ladle, a crude bird effigy (pl. 4, *H*), and a few pieces possibly representing human or animal heads were found.

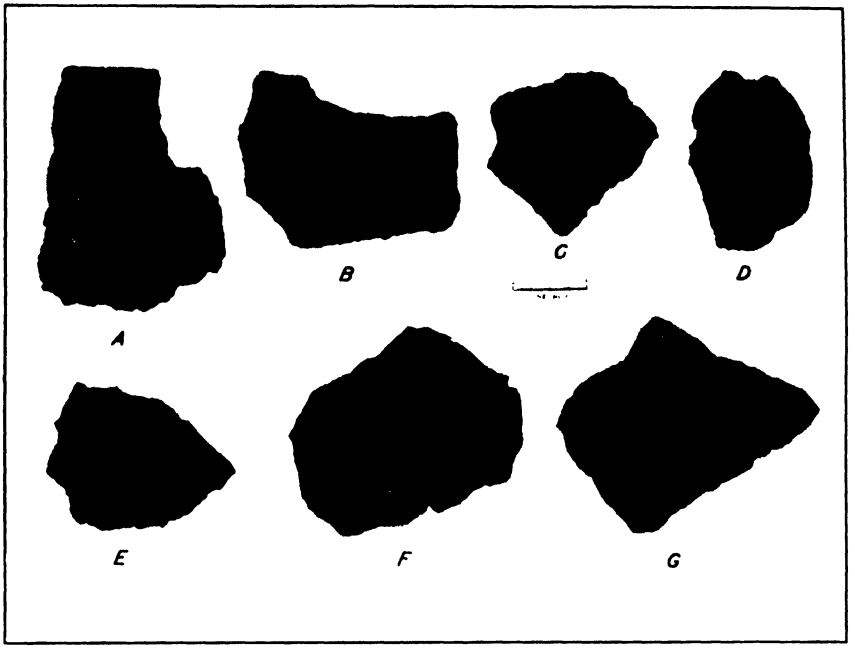
[2] Setzler, Frank M., Pottery of the Hopewell type from Louisiana. Proc. U. S. Nat Mus., vol. 82, art. 22, pp. 1–21 and references under footnote 1, 1933.



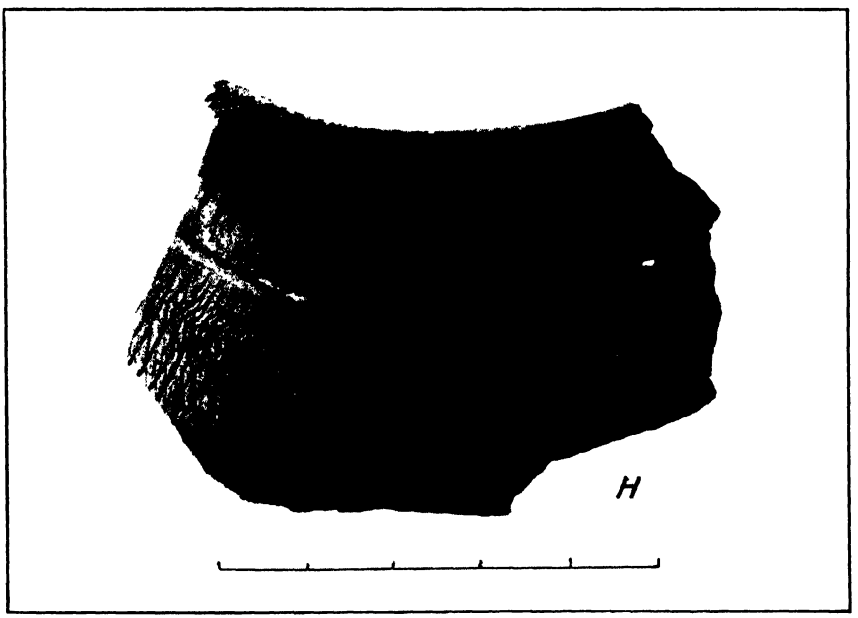
RIM AND BODY SHERDS FROM THE RENNER VILLAGE SITE.



MISCELLANEOUS STONE, BONE, HORN, AND CLAY ARTIFACTS FROM THE RENNER SITE.

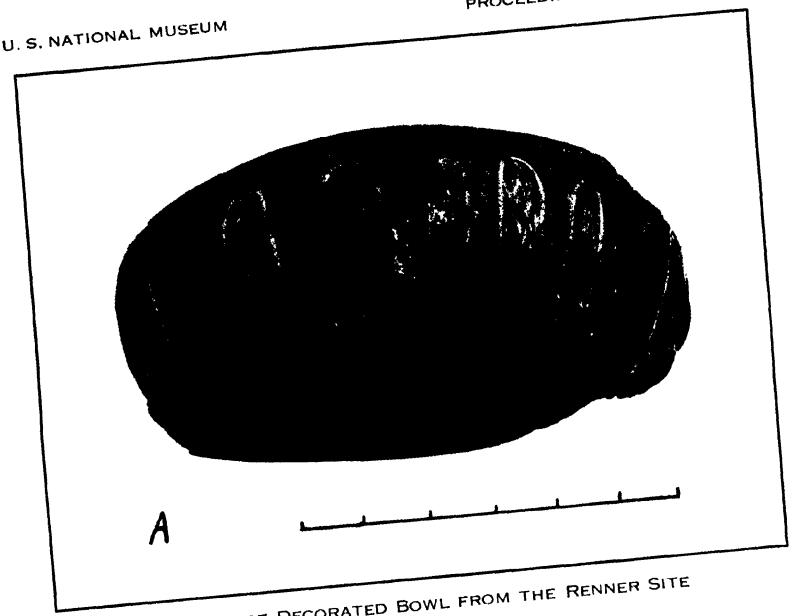


POTSHERDS FROM THE RENNER SITE



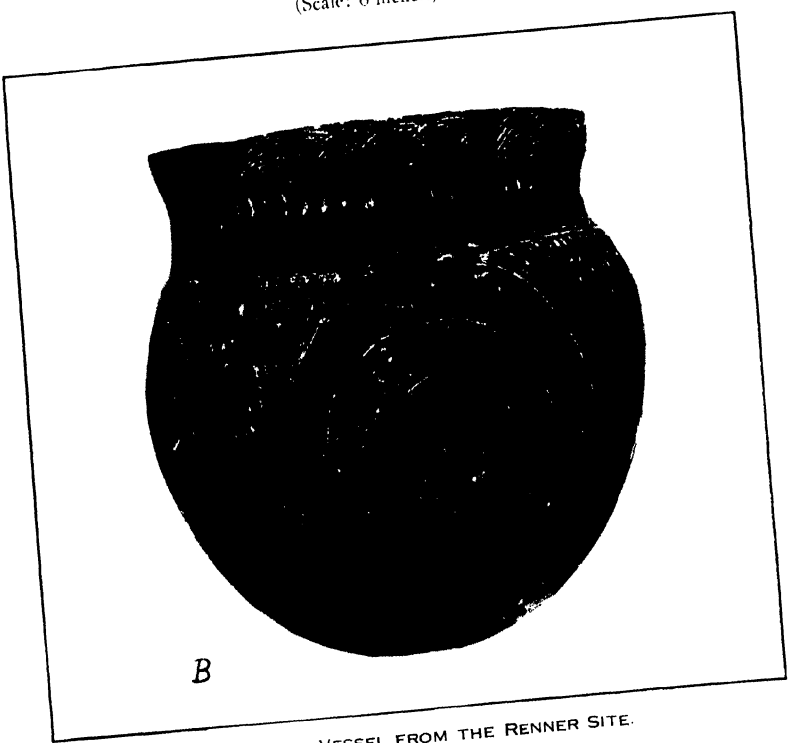
PORTION OF SQUARE VESSEL WITH ROUNDED CORNERS FROM THE RENNER SITE.

(Scale: 5 inches.)



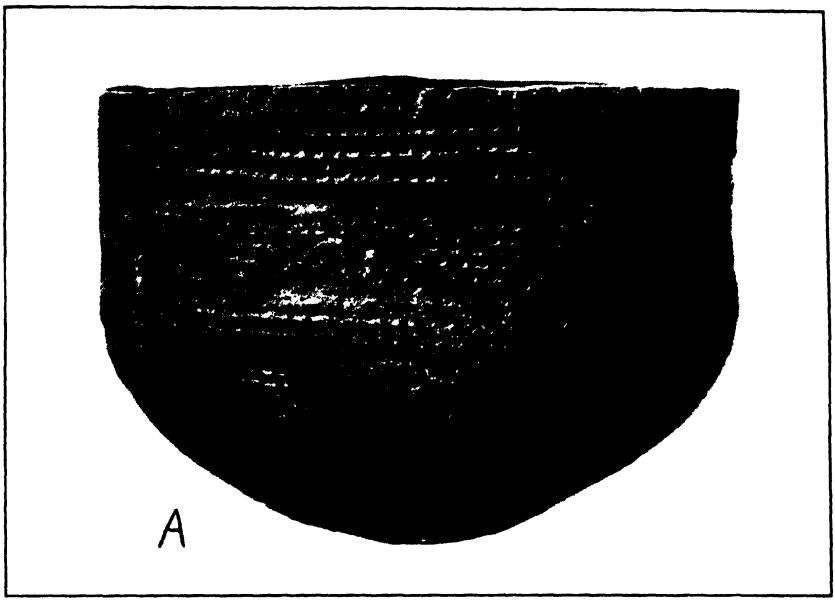
PORTION OF DECORATED BOWL FROM THE RENNER SITE

(Scale: 6 inches.)



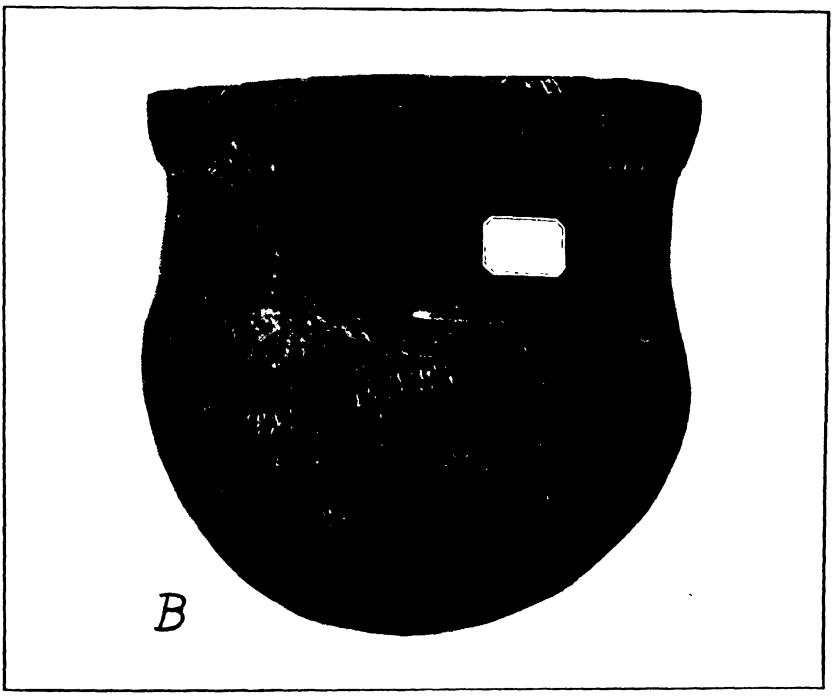
RESTORED VESSEL FROM THE RENNER SITE.

(Height, 6½ inches; diameter, 6½ inches.)



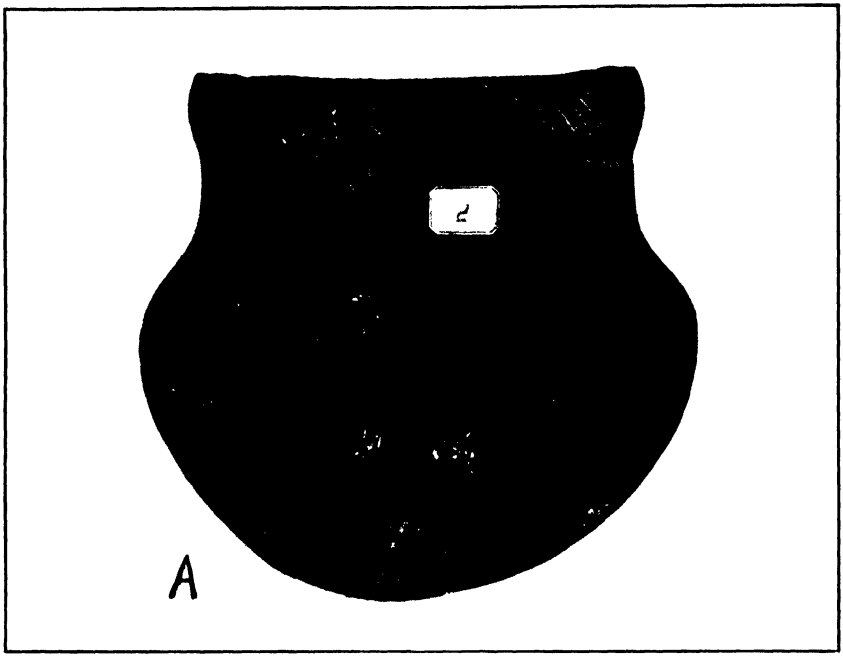
VESSEL FROM EARTH MOUND NEAR THE RENNER SITE

(Height, 3½ inches; diameter, 4¾ inches. Courtesy of J. M. Shippee.)



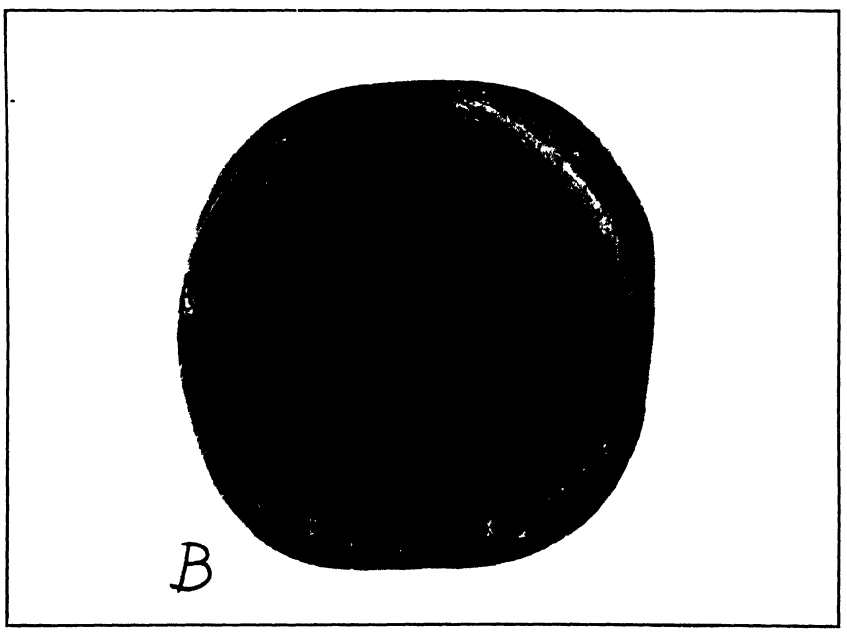
RESTORED VESSEL FROM STONE-VAULT BURIAL MOUND NEAR WALDRON, MO.

(Height, 4⅜ inches; diameter, 4½ inches. Courtesy of A. H. Hansen.)



SQUARE VESSEL WITH ROUNDED CORNERS FROM STONE-VAULT MOUND NEAR WALDRON, MO.

(Height, $5\frac{1}{4}$ inches; maximum diameter, $5\frac{3}{8}$ inches. Courtesy of A. H. Hansen.)



VERTICAL VIEW OF A.

The associated traits in stone, bone, horn, and other materials represent a somewhat greater variety than occurs in most of the known Plains archeological complexes. Work in chipped stone includes numerous heavy stemmed and a few triangular projectile points (pl. 4, *N*, *O*), medium to large end scrapers (pl. 4, *P*), a variety of knives and side scrapers, drills of straight and expanded-base types, stemmed "snub-nose" scrapers (pl. 4, *K*), and various heavier agricultural, skinning, and other tools (pl. 4, *Q*). The largest chipped specimen was a well-made brown chert or jasper blade with rounded ends measuring 10½ by 3 inches. Ground stone objects included diorite and hematite celts (pl. 4, *M*), large and small three-quarter grooved axes (pl. 4, *L*), quartzite balls and mullers, and cone-shaped or mammiform objects whose use is unknown (pl. 4, *I*). The unquestionably inclusive presence of grooved axes, including one unfinished specimen, is of interest. Implements of this type are not unknown in surface collections throughout the Plains, but so far as I am aware, the archeological complex in which they belong has never before been definitely established by excavation. Several lumps of pumice were evidently used as abradants. No pipes or pipe fragments were found.

Among the artifacts in bone are deer metapodial beamers of "draw-shave" type (pl. 4, *A*), various forms of awls, needles, a dressed deer-toe bone perforated lengthwise for cup and pin game, a long thin mat-weaving needle, imitation perforated bear teeth (pl. 4, *B*), a small carving of a bird head evidently broken from a larger object, and several unidentified forms. Conspicuously absent from the Renner site was the otherwise highly typical Plains digging tool or hoe made from the scapula of the bison, though the type occurs commonly in nearby sites of different cultural affinities and probably of later date. Socketed conical projectile points with characteristic single basal tangs (pl. 4, *D*), curved "cylinders" or tapping tools (pl. 4, *F*), flakers (pl. 4, *G*), and strainers (?) (pl. 4, *E*) were made of deer horn, while from various caches were taken several more or less complete sets of antlers. Shell was scarce; the only worked fragment found was small and nondescript, with a single perforation.

One small worked piece of probable native copper was recovered. There was no metal, glass, or other material in any way suggesting contact with Europeans.

No burials were found during the course of our excavations, but some years ago an earth mound was partially dug over by Shippee and Henneman on the bluffs overlooking the village site from the west. Interments included four stone-covered bundle and two full-length burials, as well as four unattached skulls. Scattered about through the mound dirt were pieces of red and yellow ochre and

chipped flints, the latter including a very fine 10½-inch white chert blade. There were also a few grit-tempered sherds and one small roulette decorated vase (pl. 7, *A*), but the latter was not directly associated with any of the skeletal remains. An extended infant burial yielded a few scraps of copper. The bluff north of this mound is littered with worked and unworked stone, and a large polished biperforate gorget of altered diorite is said to have been picked up on the surface here.

More recently, since our work, I have been informed that another burial mound was opened in a group on the bluffs some 12 miles upriver from the Renner site, also on the left bank of the Missouri.[3] Full details are lacking, but it appears that remains of a number of skeletons were found here in an oval chamber of coursed stones with a walled opening toward the south. There was no satisfactory evidence of a specially prepared floor or burial surface. Two incomplete male skulls and two frontal bones, including that of one infant, have been submitted to the National Museum for examination. The frontal bones in all cases are extremely narrow, and three exhibit a slight flattening above the middle on each side of the median line. Both of the crania show simple occipital deformity of moderate degree. One is evidently abnormal; the other is of dolichocranic type. The latter, it may be noted here, strikingly resembles one from the Brenner mound no. 2, described by Hrdlička and now in the national collections.[4] Marks of rodent teeth occur on the bones, suggesting that they were originally placed in an open vault. In support of this view Shippee reports that "the mounds all appear to be flat topped over the vault enclosure. I presume they once had a roof of logs and stones." Associated cultural remains included a small stone knife and two Hopewellian vessels strongly reminiscent of certain pieces from the Renner village site (pls. 7, *B*, and 8). This association, if correct, is of great interest since it would indicate a direct connection between at least one stone-vault mound and a village artifact complex similar to that described in this paper. It would be tempting to go a step further and view the Brenner, Klamm, and Keller mounds as burial places for the dead of the nearby Renner site, but in the present state of our information such a relationship can not be conclusively demonstrated. With the single apparent exception just noted, it is still impossible to identify with certainty the builders of this

[3] Excavated by Albert Hansen, who kindly forwarded the pottery and part of the skeletal material found to the U. S. National Museum for study. Information that follows was furnished by Mr. Shippee (letters of Nov. 8 and 14, 1937), who visited the mound at my request.

[4] Fowke, G., *Op. cit.*, p. 109. There is no record of pottery or other artifacts associated with this last find, made within 900 yards to the east of the Renner village site.

type of mound, which has so long puzzled students of prehistory in the Kansas City region.

Viewed in the light of Plains archeology, the complex briefly inventoried above presents a number of totally new features combined with others that have been known to workers in that area for some time.[5] Widespread throughout Nebraska and apparently also in Kansas are small often deeply buried sites distinguished by thick coarsely tempered cord-roughened sherds, with or without the rim bosses, which are much like the first type described above. These have heretofore generally been classed as Woodland, and as already stated stratigraphically they are believed to represent the earliest known ceramic horizon in the region. Little is known of the associated artifact types except that heavy stemmed projectile points are usually present. On several occasions three-quarter grooved axes have also been found on these camp sites. The relation between these small widely distributed sites with their single distinctive pottery type and such large and comparatively rich manifestations as the Renner site is still obscure. Otherwise the sherds previously described in this paper are of types not yet found in Nebraska, although our work in the Kansas valley disclosed at least one camp site with similar sherds near Manhattan, Kans., 120 miles west of Kansas City. Metapodial beaming tools have been reported sporadically from the Plains, but so far only in the precontact Upper Republican or a related context. Antler projectile points are scarce otherwise from the region save in the protohistoric Oneota and Lower Loup (Pawnee) complexes. Besides the generally more elaborate ceramic tradition, traits at the Renner site that are either rare or unknown in other described Plains archeological complexes include stemmed scrapers, an unusual variety of chipped stone objects, cone-shaped stone and clay artifacts, imitation bear teeth, and "strainers." There is little resemblance to known protohistoric and historic remains in this portion of the Missouri Valley, and in fact the complexion of the material is generally non-Plains.

Despite the absence of a detailed tabular analysis by depths of the Renner site materials, it seems evident that all these various artifact types represent the remains of a single occupancy. Possibility of a mechanical mixing of vestiges from distinct culture strata is ruled

[5] See: Wedel, W. R., Reports on fieldwork by the Archeological Survey of the Nebraska State Historical Society, May 1–July 23, 1934, Nebraska Hist. Mag., vol. 15, pp. 132–255, 1934.—Strong, W. D., An introduction to Nebraska archeology, Smithsonian Misc. Coll., vol. 93, no. 10, 1935.—Hill, A. T., and Wedel, W. R., Excavations at the Leary Indian village and burial site, Richardson County, Nebraska, Nebraska Hist. Mag., vol. 17, pp. 3–73, 1936.—Wedel, W. R., An introduction to Pawnee archeology, Bur. Amer. Ethnol. Bull. 112, 1936.—Bell, E. H., et al., Chapters in Nebraska archeology, vol. 1, University of Nebraska, 1936.—Hill, A. T., and Cooper, Paul, papers in Nebraska Hist. Mag., vol. 17, pp. 222–292, 1937.

out by the fact that the great bulk of the material came from a relatively homogeneous and unstratified deposit below plow sole and out of the old trash pits. Furthermore, the Renner site is not unique in the Kansas City area. Five or six miles to the west on a small unnamed creek about a mile south of the Missouri, in Wyandotte County, Kans., nearly identical remains have been unearthed by H. M. Trowbridge, of Bethel. Practically every artifact and pottery type enumerated above from the Renner site can be duplicated in the Trowbridge collection. Surface finds have revealed good evidence for recurrence of the complex at five or six other smaller sites recorded in and below Kansas City, and it is quite likely that still others will eventually be found both up and down the Missouri River from this known area of occurrence.

A brief survey of the more recent literature on the archeology of the upper Mississippi drainage suggests that the Renner site and similar remains in the vicinity may prove to be rather closely related to certain Hopewellian manifestations in parts of Illinois and Wisconsin.[6] From the limited studies so far made, it is not yet clear to which, if any, of the currently recognized aspects of the Hopewellian phase the newly identified Missouri Valley variant is assignable. It apparently lacks among other things many of the practices connected with disposal of the dead farther east and south, although the evidence hints at a basic similarity even here. Possibly further work will show that these remains comprise the Kansas City focus of an as yet unnamed westerly aspect of the Hopewellian. This point, as well as the exact position of the complex in Missouri Valley archeology temporally and otherwise, must remain problematical until systematic investigations have been made in additional related sites and in some of the fast-vanishing burial mounds of the Kansas City area.

[6] McKern, W. C., A Wisconsin variant of the Hopewell culture, Milwaukee Public Mus. Bull., vol. 10, no. 2, 1931.—Cole, F. C., and Deuel, T., Rediscovering Illinois, Chicago, 1937.

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THE TYPES OF THE POLYCHAETE WORMS OF THE FAMILIES POLYNOIDAE AND POLYODONTIDAE IN THE UNITED STATES NATIONAL MUSEUM AND THE DESCRIPTION OF A NEW GENUS

By Olga Hartman

A survey of the types of annelids of the families Polynoidae and Polyodontidae in the United States National Museum indicates the necessity of several nomenclatorial changes. The first part of this paper is a discussion of some of these types and a revision of some of the genera concerned. The second part lists all the types in the Museum, with changes of names and new combinations indicated. For convenience, type locality, place of publication, and museum catalog number are given.

Family POLYNOIDAE

Genus IPHIONE Kinberg

IPHIONE FUSTIS Hoagland

Figure 35, *a*

Iphione fustis Hoagland, 1920, p. 605 (U.S.N.M. no. 18941; Philippine Islands).

The type may be an immature individual, as already stated by Hoagland. The paired prostomial antennae have their cirrophores and cirrostyles subequal. The place of articulation was not indicated by the describer, but the total length is about as shown. Neuropodia are considerably more oblique that Hoagland has shown, and the neuropodial aciculum projects beyond the parapodial lobe; neurocirri are long, digitiform (fig. 35, *a*).

Genus LEPIDONOTUS Leach

LEPIDONOTUS CAELORUS Moore

FIGURE 35, *b–d*

Lepidonotus caelorus MOORE, 1903, p. 412 (U.S.N.M. no. 15733; Japan).
Polynoë spicula TREADWELL, 1906, p. 1151 (U.S.N.M. no. 5203; Monterey Bay).
Lepidonotus minutus TREADWELL, 1936, p. 262 (U.S.N.M. no. 20112; China).
? *Lepidonotus castriensis* SEIDLER, 1924, p. 41.

The type vial of *Polynoë spicula* contains three specimens. Each has 12 pairs of elytrophores, inserted as typical of the genus *Lepidonotus*. The prostomium has long anterior peaks and a stout median ceratophore; lateral antennae are inserted terminally (fig. 35, *c*). The scales are ornamented with spines and a marginal fringe (fig. 35, *d*). Neuropodial setae are distally entire and have a stout tooth

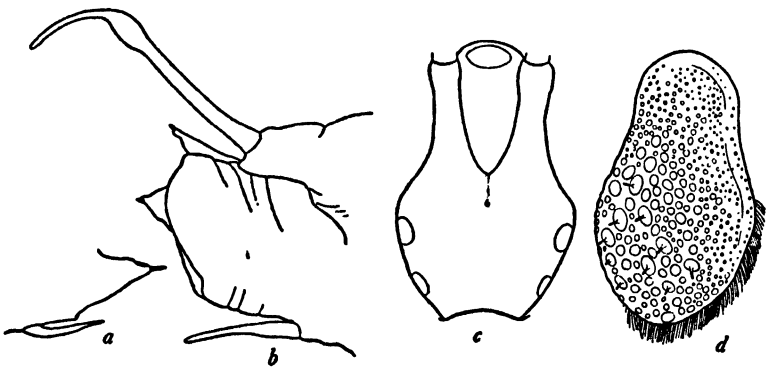


FIGURE 35.—Species of IPHIONE and LEPIDONOTUS

a, Iphione fustis Hoagland: Fifteenth neuropodium in posterior view, × 45.
b–d, Lepidonotus caelorus Moore (figures based on type of *Polynoë spicula* Treadwell): *b*, Twelfth foot in anterior view, × 45; *c*, prostomial outline, × 45; *d*, an elytron from posterior third of body, × 28.

at the distal end of the toothed region. Parapodia are blunt, truncate (fig. 35, *b*). In both the types of *L. caelorus* and *P. spicula* the posteriormost scales have the most conspicuous spines. Numerous collections show variation, however, in relative sizes of spines.

The type of *Lepidonotus minutus* Treadwell is a small representative of this common north Pacific species. The prostomium is strongly retracted into the peristomial ring, and the posterior margin is thus made out with difficulty. It may be for this reason that the illustration of *L. minutus* shows the prostomium more produced at its posterior margin than is actually the case. The elytra of the type are strongly mottled with dark gray. There is great variation in pigmentation of this species (see also Moore, 1905, p. 546). The lengths of lateral and median antennae in the original descriptions of

L. caelorus and *L. minutus* are seemingly reversed, but the degree of variation in this respect has already been commented upon (Moore, 1908, p. 331) and is observable in numerous collections examined.

Lepidonotus castriensis Seidler, from northeastern Asia, is close to, if not identical with, *L. caelorus* Moore. The descriptions agree reasonably well. Seidler describes the elytra as beset with large "Schuppen . . . die jede in der Mitte einen Höcker zeigt." The so-called "Höcker" are presumably the spines, shown by Moore (1905, fig. 36, *a–c*). Seidler has not described or illustrated the shape of a typical parapodium, but the setal structures, prostomial proportions, and elytra are similar.

LEPIDONOTUS HELOTYPUS (Grube)

Polynoë (*Lepidonotus*) *helotypus* GRUBE, 1877, p. 49 (China).
Lepidonotus robustus MOORE, 1905, p. 544 (U.S.N.M. no. 5523; Alaska).
(See Seidler, 1924, p. 56, for more complete synonymy.)

Grube's type from China measures 56 mm long; Moore's type from Shelikof Strait, Alaska, measures 45 mm. long. Seidler (1924, p. 56) indicated the possible identity of Moore's type with *L. helotypus* but gave no explanation. It seems that this synonymy may be verified in view of the similarity of the type of *L. robustus* with the description of *L. helotypus* given by Seidler, who examined Grube's type.

Genus HALOSYDNA Kinberg, char. emend.

Body moderately short, depressed; number of setigerous segments about 36; number of eltytra 18 (rarely 19), distributed on segments 2, 4, 5, 7, 9 . . . 27, 28, 30, 31, 33 (or rarely also on 34). Otherwise as defined by Kinberg.

Type of genus: *Halosydna patagonica* Kinberg, from southern Chile.

The genus *Halosydna*, as restricted above, includes the following species which I believe to be valid:

brevisetosa **Kinberg (California).**
latior **Chamberlin (California).**
nebulosa **Grube (China).**
pissisi **(Quatrefages) (Brazil).**
fuscomarmorata **(Grube) (Peru).**
elegans **Kinberg (Galapagos Islands).**
johnsoni **(Darboux) (California).**
müllerí **(Grube) (Chile).**
parva **Kinberg (Chile).**
patagonica **Kinberg (Straits of Magellan).**
leucohyba **(Schmarda) (Jamaica).**
virgini **Kinberg (Hawaiian Islands).**
marginata **(Grube) (Peru).**
samoensis **Grube (Samoa).**
tuberculifer **Chamberlin (California).**

The following names, described in the genus *Halosydna*, all based on specimens from California, seem to be synonyms or species in other genera:

Halosydna lagunae Hamilton (1915, p. 235) is a *Lepidonotus*.
Halosydna leioseta Chamberlin (1919b, p. 2) is *Arctonoë pulchra* (Johnson).
Halosydna macrocephala Essenberg (1917, p. 53) is *H. johnsoni* (Darboux).
Halosydna succiniseta Hamilton (1915, p. 234) is *Arctonoë vittata* (Grube).

HALOSYDNA LATIOR Chamberlin

Halosydna latior CHAMBERLIN, 1919b, p. 1 (California).
Halosydna obtusa-cirrata TREADWELL (1937b, p. 143) (Lower California).

Halosydna obtusa-cirrata Treadwell, from Lower California, compares favorably with *H. latior* Chamberlin, from southern California. *H. latior* is readily distinguished from other species of *Halosydna* by its broad depressed form and its closely imbricated, broadly reniform scales, which have a conspicuous fringe on the outer lateral border. Another characteristic feature mentioned by Chamberlin, but not described for *H. obtusa-cirrata*, is the elongate nature of the nephridial papillae; they are about three times as long as thick. I have observed this feature in numerous specimens deposited in the collections of the University of California.

Specimens of *H. latior* have been taken in abundance from the deeper waters of southern California by expeditions of the steamer *Albatross*. Many of these collections have not been reported upon. They are deposited in the University of California and the United States National Museum.

HALOSYDNA LEUCOHYBA (Schmarda)

Polynoë leucohyba SCHMARDA, 1861, p. 309 (Jamaica).
Halosydna leucohyba WEBSTER, 1884, p. 309 (Bermuda).
Halosydna brevisetosa TREADWELL, 1902, p. 166 (U.S.N.M. nos. 16009–16012) (Puerto Rico); not Kinberg, 1855, p. 385.

Specimens of *H. brevisetosa* Treadwell, from Puerto Rico, are all representatives of *H. leucohyba* (Schmarda) as redescribed by Webster. *H. brevisetosa* Kinberg is thus not known outside of the eastern Pacific.

HALOSYDNELLA, new genus

Resembling *Halosydna* Kinberg in prostomium and body contour but longer. Differs from *Halosydna* in having about 45 setigerous segments and 20 to 24 pairs of scales, inserted on segments 2, 4, 5, 7, 9 . . . 23, 25, 28, 29, 32, and on every second or third segment more posteriorly. Ventral setae distally entire or with a subterminal tooth (fig. 36, *e*). Dorsal setae finer than ventral setae and ornamented with transverse rows of spines. Notopodial setae may be absent from some posterior parapodia.

Type of genus: *Halosydna australis* Kinberg, from the La Plata River.

The following species belong to the genus *Halosydnella:*

Halosydna australis Kinberg, from the La Plata River.
Halosydna brasiliensis Kinberg, from Brazil.
Halosydna fusca Grube, from Brazil.
Halosydna alleni Day, from False Bay, South Africa.
Halosydna grisea Treadwell, from Argentina.
Polynoë punctulata Grube, from Brazil.
Halosydna galapagensis Monro, from the Galapagos Islands.
Halosydna oculata Treadwell, from Samoa.
Halosydna fusca-maculata Treadwell, from the Barbados.

A comparative study of the types of these species, especially those from the eastern coast of South America, may reveal the identity of some of them.

HALOSYDNELLA GRISEA (Treadwell), new combination

FIGURE 36, *d, e*

Halosydna grisea TREADWELL, 1929, p. 1 (U.S.N.M. no. 19279; Argentina).
? *Halosydna australis* KINBERG, 1855, p. 385 (La Plata River).

In the type, the lateral margin of the scales of the posterior half of the body is quite smooth, the margin of the anterior scales is successively more ciliate, the scales 2 to 8, at least, being ciliate along their entire free lateral edges, where they do not overlap one another. Neuropodia are distally truncate, extending laterally well beyond the papillate notopodium (fig. 36, *d*). Neuropodial setae number 12 to 15 in a fascicle and are arranged in two more or less irregular vertical ranks. The subterminal tooth is well outdistanced by the terminal fang (fig. 36, *e*). There are 4 to 9 transverse rows of pectinae along the thickened region.

The identity of *H. grisea* and *H. australis* seems likely in view of the similarities that are to be observed in comparing Kinberg's description and figures with the type of *H. grisea*. Both are from Argentina.

HALOSYDNELLA FUSCA-MACULATA (Treadwell), new combination

FIGURE 36, *f, g*

Halosydna fusca-maculata TREADWELL, 1924, p. 5 (U.S.N.M. no. 20330; West Indies).
Halosydna fuscomarginata TREADWELL, 1924 (in explanation of figures).

The type has 45 setigerous segments and 21 pairs of elytrophores. Prostomium and elytra are as indicated by Treadwell. The scales, posterior to the first pair, are tiny and leave the dorsum broadly exposed; those on a side are widely separated from one another by almost the length of a segment. I was unable to detect a subterminal

tooth in the neuropodial setae (fig. 36, *f*). Treadwell reported the presence of a subapical tooth in superior neuropodial setae. These setae have 7 to 10 rows of pectinae, restricted more completely to the outer side than in *H. grisea*. Notopodia are papillar, reduced, typically with only an aciculum (fig. 36, *g*).

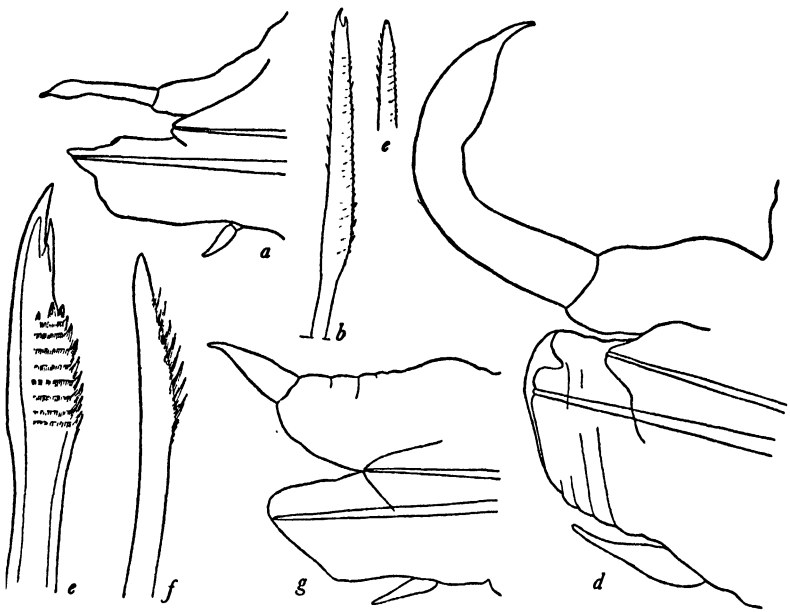


FIGURE 36.—Species of HALOSYDNELLA, new genus

a–c, Halosydnella oculata (Treadwell) : *a*, Twentieth parapodium in posterior view, × 45; *b*, a median neuropodial seta from twentieth parapodium, × 294; *c*, tip of dorsalmost neuropodial seta from twentieth parapodium, × 294.

d, e, Halosydnella grisea (Treadwell) : *d*, Twentieth parapodium in posterior view, × 45; *e*, tip of neuropodial seta from twentieth parapodium, × 294.

f, g, Halosydnella fusca-maculata (Treadwell) : *f*, Neuropodial seta from twentieth parapodium, × 294; *g*, twentieth parapodium in posterior view, × 45.

Unidentate neuropodial setae have been described for *H. galapagensis* (Monro, 1928, p. 565). These two differ, however, in the shape of the feet, the dorsal cirrophore is notably stouter in *H. fusca-maculata*, and the notopodium is more reduced.

HALOSYDNELLA OCULATA (Treadwell), new combination

FIGURE 36, *a-c*

Halosydna oculata TREADWELL, 1926, p. 8 (U.S.N.M. no. 19141; Samoa).

The type consists of a complete specimen with 46 (possibly 47) setigerous segments and has 21 pairs of elytrophores, on segments 2, 4, 5, 7, 9 . . . 23, 26, 29, 32, 35, 38, 40, 43, 44, 45 on the right side. A typi-

cal parapodium (20th) has 60 or more neuropodial setae and only 20 or less notopodial setae. The prostomium is unique in that it is broadly subquadrate and the lateral antennae are inserted ventrolaterally (see Treadwell, 1926, fig. 9). There is a nuchal hood extending forward from the peristomium.

Neuropodial setae are long, slender, with distal bladelike portion not much wider than the stem (fig. 36, *b*); terminal end is bifid. The accessory tooth is largest in inferiormost setae (fig. 36, *b*), hardly visible in the superiormost setae (fig. 36, *c*). Transverse rows of pectinae are numerous on the cutting edge but exceedingly fine; these are accompanied with a few heavier teeth on median and ventral bristles; the opposite edge or back, has a row of teeth (fig. 36, *b*). Notopodial setae include a few straight, smooth, acicular rods and more numerous straight setae resembling the superiormost neuropodial setae but apparently entire at the tip, and with fainter rows of pectinae.

Genus HYPERHALOSYDNA Augener

HYPERHALOSYDNA STRIATA (Kinberg)

Lepidonotus striatus KINBERG, 1855, p. 384 (Australia).
Polynoë platycirrus MCINTOSH, 1885, p. 111 (Australia).
Hylosynda carinata MOORE, 1903, p. 417 (U.S.N.M. no. 15732; "off Japan").

This species has been well described by Moore and by Augener (1922, p. 4; 1927, p. 105). It is present in the tropical and subtropical Pacific.

Genus LEPIDASTHENIA Malmgren

LEPIDASTHENIA LUCIDA (Treadwell), new combination

FIGURE 37 *a-c*

Polynoë lucida TREADWELL, 1906, p. 1150 (U.S.N.M. no. 5202; off Hawaiian Islands).

The type is a fragment consisting of the head and 64 setigerous segments; a posterior portion is missing. Lateral antennae are inserted terminally. The notopodia are greatly reduced (fig. 37, *a*), without setae but with a slender aciculum. Neuropodia are elongate, deepest subterminally, with presetal and postsetal lobes broadly triangular and about equally long (fig. 37, *a*).

Neuropodial setae are of two kinds: A few very slender, superior setae (fig. 37, *c*) and a fan-shaped fascicle of numerous thicker setae (fig. 37, *b*). Peristomium has a nuchal hood that extends forward over the prostomium, its enterior margin in line with the anterior margin of the posterior pair of eyes.

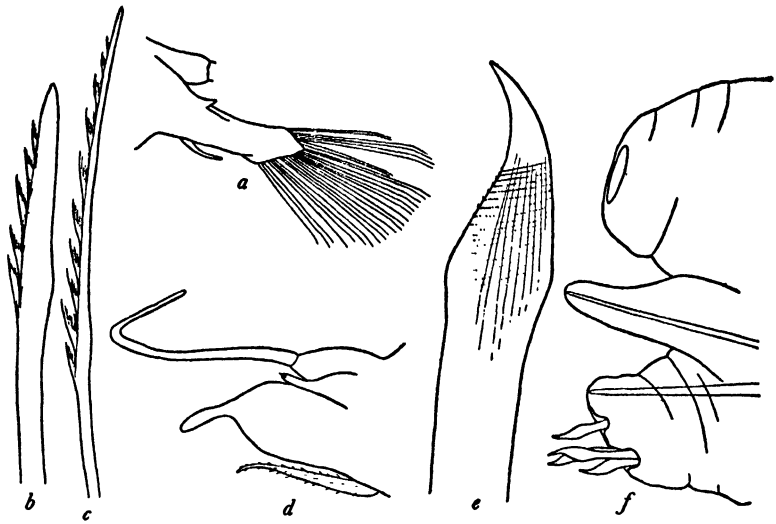


FIGURE 37.—Species of LEPIDASTHENIA, EUNOË, and ARCTONOË

a–c, Lepidasthenia lucida (Treadwell) : *a*, Thirty-fifth parapodium in anterior view, setae diagrammatically represented, dorsal cirrus lost, × 28; *b*, tip of inferior neuropodial seta from thirty-fifth parapodium, × 294; *c*, tip of superior neuropodial seta from thirty-fifth parapodium, × 294.

d, Eunoë eura Chamberlin : Fourteenth parapodium in anterior view, × 28.

e, f, Arctonoë tuberculata (Treadwell) : *e*, Tip of neuropodial seta from tenth parapodium, × 294; *f*, tenth parapodium in anterior view, dorsal cirrus lost, × 45.

LEPIDASTHENIA ALBA (Treadwell), new combination

Polynoë alba TREADWELL, 1906, p. 1149 (U.S.N.M. no. 5201; Honolulu).

The type compares favorably with the description given for *L. longicirrata* Berkeley (1923, p. 214) except that the latter has a row of papillae on the feet between the bases of the ventral cirrus and the body wall. *L. longicirrata* Treadwell (1928, p. 460) from west of Peru is probably a *Halosydna* Kinberg. The type is deposited with the New York Zoological Society.

The type of *L. alba* differs, in part, from *L. lucida* (see above) in having shorter, blunter parapodia; also, presetal and postsetal lobes are oblique in *L. alba*, triangular in *L. lucida*.

LEPIDASTHENIA INTERRUPTA (Marenzeller)

Halosydna interrupta MARENZELLER, 1902, p. 570 (Japan).
Polynoë semierma MOORE, 1910, p. 331 (U.S.N.M. no. 15738; Japan).
Lepidasthenia ocellata TREADWELL, 1936, p. 264 (U.S.N.M. no. 20113; China).

P. semierma Moore has long been considered a synonym of *L. interrupta* (see Moore, 1910, p. 331).

The type and description of *L. ocellata* agree favorably with the description of *L. interrupta*, which has been widely reported from the northwest Pacific.

Genus EUPHIONE McIntosh

EUPHIONE CHITONIFORMIS (Moore)

Lepidonotus chitoniformis MOORE, 1903, p. 405 (U.S.N.M. no. 15646; Japan).
?*Lepidonotus branchiferus* MOORE, 1903, p. 409 (U.S.N.M. no. 15721; Japan).
(See Seidler, 1924, p. 108).

Lepidonotus chitoniformis Moore has been transferred correctly to the genus *Euphione* by Seidler (1922, 1924). Seidler, furthermore, considered *L. branchiferus* identical with *L. chitoniformis*. The type specimens, however, differ from one another in the character of the major spines on the elytra. In *E. chitoniformis* these spines are nodular, the 6 to 15 blunt nodes produced about the tip of a club-shaped stalk in which the stem is generally smooth. In *E. branchiferus* the major spines are closely covered with sharp-pointed stellate spinelets, which are continued on the stalk and on the terminal knob. Both types were collected from almost the same depth (49–63 and 34–41 fathoms, respectively) from Sagami Bay.

Genus ARCTONOË Chamberlin, char. emend.

Arctonoë CHAMBERLIN, 1920, p. 6B.
Includes *Halosydnoides* SEIDLER, 1924; *Halosydna* KINBERG (pars); *Polynoë* (pars); *Lepidonotus* (pars); *Acholoë* (pars).

Body depressed, moderately long, consisting of a varying number of segments, ranging from 39 [?] to 60 or more. Elytra 18 pairs or more, continued to end of body but often leaving a broad dorsal area exposed, inserted as in *Halosydna* Kinberg on the first 26 segments, insertion more or less irregular more posteriorly. Last few pairs of scales usually small, delicate. Prostomium much as in *Halosydna*, except that the eyes may be reduced or absent and the lateral paired antennae inserted somewhat ventrolaterally.

Parapodia unequally biramous, the smaller notopodium provided with an aciculum and few or no setae; notopodial setae straight, slightly pectinated or quite smooth, distal end blunt, indiscretely bifid. Neuropodia often robust, though short, truncate, each provided with a heavy aciculum and few to many stout, falcate setae, lacking pectinae or with faint transverse rows of teeth. Falcate setae are sometimes accompanied by a few superior neurosetae resembling those of the notopodium. Ventral cirri present on at least the first two segments, those of the first resembling the dorsal cirri, with a subterminal knob, those of the second cirriform. Ventral cirri of other segments moderate to inconspicuous or absent. Dorsal cirri more or less similar throughout.

Elytra soft, translucent, with few or no spines or nodules, lateral margins smooth to greatly frilled, lacking noticeable cilia or hairs.

Commensal, in ambulacral grooves of echinoderms or branchial chambers of mollusks.

Type species: *Arctonoë vittata* (Grube), new combination.

Discussion.—The genus *Arctonoë* includes a small group of annelids that differ, by degrees, in the reduction or loss of certain parts, such as the number of notopodial setae, presence or absence of ventral cirri, number of segments and of scales, size of eyes. The habit of commensalism is possibly largely responsible for certain of these reductions or deletions. All known species are similar in that they have the peculiar, heavy, falcate neuropodial setae adapted for attaching to their hosts, and in other respects enumerated above.

The first species of this group, *Polynoë vittata*, was described from Alaska by Grube (1855, p. 82). It has subsequently been delegated to the genera *Lepidonotus* (Baird, 1863, p. 107), *Halosydna* (Baird, 1865, p. 190), *Acholoë* (Marenzeller, 1902, p. 576), and *Halosydnoides* (Seidler, 1921, p. 134). It has been described as *Lepidonotus lordi* Baird (1863, p. 107), as *Halosydna succiniseta* Hamilton (1915, p. 234 [new syn.]), and more recently as *Arctonoë lia* Chamberlin (1920, p. 6B [new syn.]). Since Chamberlin's name *Arctonoë* precedes *Halosydnoides* Seidler (1924), the former is used.

There are now four known species that may be assigned to the genus *Arctonoë*. They are: *Polynoë vittata* Grube (1855, p. 82), *Lepidonotus fragilis* Baird (1863, p. 108), *Polynoë pulchra* Johnson (1897, p. 177), and *Harmothoë tuberculata* Treadwell (1906, p. 1154) (see below). The first three of these have not been reported outside of the north Pacific, and *A. pulchra* and *A. fragilis* are known only in the northeast Pacific. *A. tuberculata* is known only from the Hawaiian Islands (Treadwell, 1906).

An interesting correlation of host species may be observed. All are more or less commensal with asteroids. *A. vittata* is more commonly with fissurellids, though sometimes also on chitons and even in tube of *Thelepus* (Berkeley, 1935, p. 212). *A. pulchra* is more frequently with holothuroids.

KEY TO THESE SPECIES OF ARCTONOË

1. Dorsum of each segment with a conspicuous median papilla; notopodial setae absent; neuropodial setae with vestiges of pectinae (fig. 37, *e*)---------- **tuberculata**
 Dorsum without such papillae; notopodial setae present on at least a few anterior segments though often reduced in size and number; neuropodial setae without pectinae---------- 2
2. External margins of elytra greatly ruffled or folded---------- **fragilis**
 External margins of elytra smooth or only slightly ruffled---------- 3
3. Some superior neurosetae with bifid tip; dorsum usually with a dark pigment band across segments 7–8---------- **vittata**
 Superior neurosetae resembling inferior ones; dorsum without transverse band of pigment---------- **pulchra**

ARCTONOË TUBERCULATA (Treadwell), new combination

FIGURE 37, *e*, *f*

Harmothoë tuberculata TREADWELL, 1906, p. 1154 (U.S.N.M. no. 5205; Hawaii).

The type is an ovigerous adult, its total length about 15 mm, its greatest width between segments 12 and 14 about 3 mm. All elytra and dorsal cirri have been lost. Ventral cirri of the first two segments remain and are moderately developed, as typical of the genus *Arctonoë*, defined above. The ventral cirri are completely lacking (fig. 37, *f*). Parapodia are short, broad, thick, similar throughout. The notopodium is reduced to a fingerlike lobe, extending distally beyond the neuropodium (fig. 37, *f*), provided with a slender aciculum and a few (3 to 6) falcate setae, smooth along their lateral margins except for a few closely set, transverse rows of minute pectinae in the subterminal region (fig. 37, *e*).

The prostomium is macerated, its anterior appendages not discernible, its posterior margin partly overlapped by a peristomial nuchal hood.

Genus HARMOTHOË Kinberg

HARMOTHOË ACULEATA Andrews

Harmothoë aculeata ANDREWS, 1891, p. 278 (U.S.N.M. no. 4876; North Carolina).

The type vial contains several specimens, 7 with anterior ends of which 3 are more or less complete. Total number of setigerous segments varies from 34 to 36. *H. aculeata* resembles the European *H. areolata* Grube; the areolations of the elytra, however, are much less marked in *H. aculeata*, and the spines of the first pair of scales are shorter than those more posteriorly. A characteristic feature is the neuropodial lobe, which is prolonged into a slender, dorsal, attenuated tip (see Andrews, 1891, fig. 3).

HARMOTHOË VILLOSA Treadwell

Harmothoë villosa TREADWELL, 1926, p. 10 (U.S.N.M. no. 19190; Samoa).

Both dorsal and ventral cirri are hirsute, as are also the prostomial antennae. Palpi are smooth. This species approaches *H. hirsuta* Johnson in the character of its prostomium and appendages, its notopodial and neuropodial setae, and the proportions of the parapodia. The elytra are ciliate along their outer, lateral margins and spiny, but there are no definite polygonal areas such as Johnson first described for *H. hirsuta* (Johnson, 1897).

Ditlevsen (1917, p. 36) assigned *Eucranta villosa* Malmgren (1865, p. 80) to the genus *Harmothoë*. This species is a *Eucranta* Malmgren.

HARMOTHOË TRIMACULATA (Treadwell), new combination

FIGURES 38, *a*; 39, *a*, *b*

Evarnella trimaculata TREADWELL, 1924, p. 6 (U.S.N.M. no. 20326; West Indies).

The type of this species has been deposited in the United States National Museum by the University of Iowa. It is being allocated to the genus *Harmothoë* because of the similarity of the neuropodial setae with one another and the anterior position of the eyes. Parapodia are long, extending laterally considerably beyond the scales (fig. 38, *a*). Dorsal and ventral cirri are hirsute. The neuroacicular lobe is prolonged in a papillar lobe. A typical parapodium (12th) is provided with about 12 stout, pectinated notopodial setae (fig. 39, *b*) and about 10 slightly slenderer, bifid neuropodial setae (fig. 39, *a*). The ventralmost neuropodial setae have the pectinated region more limited than those more dorsally; it is only about half as long as that of the dorsalmost setae.

H. trimaculata resembles *H. variegata* Treadwell (1917, p. 260) from Florida. I have not seen the type of the latter. The elytral color markings are somewhat different, the anterior eyes much smaller, and the parapodia said to be shorter, but whether these differences are real or of no significance is not certain.

HARMOTHOË TENEBRICOSA Moore

Harmothoë tenebricosa MOORE, 1910, p. 351 (U.S.N.M. no. 16877; California).
Eunoë exoculata TREADWELL, 1923, p. 4 (U.S.N.M. no. 19148; Lower California).

Eunoë exoculata is identical with *Harmothoë tenebricosa*. The general aspect of *E. exoculata* is darker and the setae are a deeper amber color. A paratype of *H. tenebricosa* (U.S.N.M. no. 17153) is somewhat darker than the type but not so dark as *E. exoculata*. In other respects the two types are very similar. The characteristic neuropodial lobes, setae, and prostomium readily distinguish this species (cf. figures of Moore, 1910, and Treadwell, 1923).

HARMOTHOË TRIANNULATA Moore

Harmothoë triannulata MOORE, 1910, p. 346 (U.S.N.M. no. 17154; California).
? *Harmothoë bonitensis* ESSENBERG, 1917, p. 48 (California).

The description of *H. bonitensis* agrees reasonably well with that of *H. triannulata*. I have seen Essenberg's type at the University of California and Moore's type at the National Museum but have not compared them side by side.

Genus EUNOË Malmgren

EUNOË (?) CRASSA (Treadwell), new combination

FIGURE 38, *b–e*

Lagisca crassa TREADWELL, 1924, p. 1 (U.S.N.M. no. 19101, Chile).

The type is a fragment consisting of 32 anterior segments. The last segment is provided with the fifteenth elytrophore. I could discern no bifid neuropodial setae. The dorsalmost resembled the ventralmost (figs. 38, *d*, *e*) except for the decreasing length of blade and the

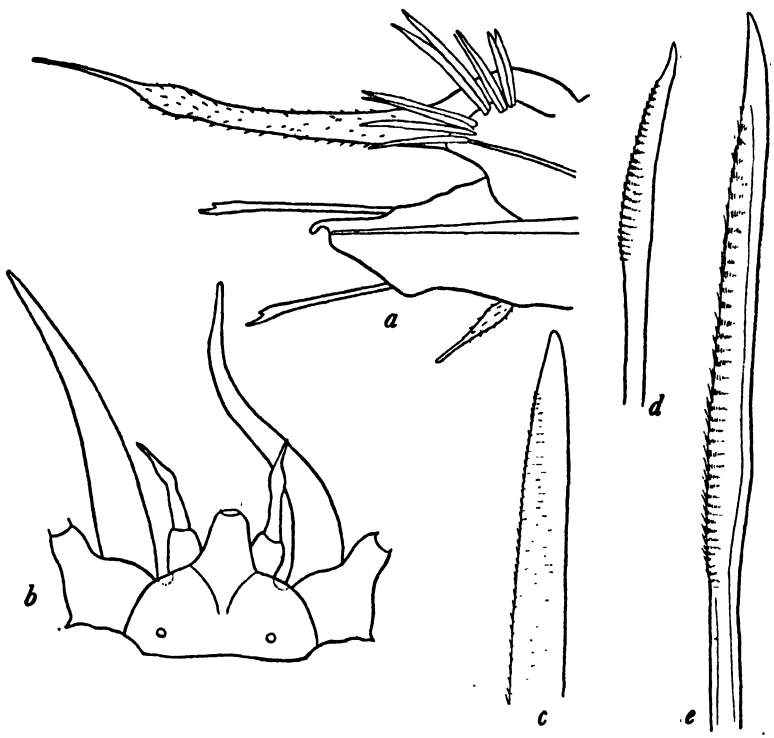


FIGURE 38.—Species of HARMOTHOË and EUNOË

a, *Harmothoë trimaculata* (Treadwell): Twelfth parapodium in anterior view, notopodial setae indicated, uppermost and lowermost neurosetae shown, × 38.

b–e, *Eunoë crassa* (Treadwell): *b*, Prostomium and surrounding parts, × 23; *c*, tip of notopodial seta from a median parapodium, × 75; *d*, inferiormost neuropodial seta from same parapodium, × 75; *e*, superiormost neuropodial seta from same fascicle as *d*, × 75.

smaller size of the ventral bristles. The few scales that remain (the left on segments 4, 5, and 7 and a pair on 29) are tough, firmly attached, suborbicular and partly overlain, laterally, by the fascicles of spinelike notopodial setae.

Anterior pair of eyes are directed forward; the base of the paired prostomial antennae is over half as long as the main portion of the style. Palpi, antennae, and cirri are smooth (fig 38, *b*). Acicula and setae are dark amber, but the distal ends of the acicula are darker and project beyond the acicular lobes. Notopodial setae are entire distally, the transverse rows of pectinae fine, numerous, and extensive in width (fig. 38, *c*).

EUNOË EURA Chamberlin

FIGURE 37, *d*

Eunoë eura CHAMBERLIN, 1919a, p. 58 (U.S.N.M. no. 19355, Peru).

Notopodial and neuropodial setae are slender, about equally thick, with extensive pectinated region. Acicular lobes of both notopodia and neuropodia are long, digitate throughout (fig. 37, *d*). The notoaciculum emerges near the tip of the lobe, the neuroaciculum about halfway on the free length of the lobe. Ventral cirri are ciliate, dorsal cirri smooth.

Genus ENIPO Malmgren

ENIPO CIRRATA Treadwell

FIGURE 39, *d*, *e*

Enipo cirrata TREADWELL, 1925, p. 1 (U.S.N.M. no. 19139, Alaska).

Notopodial setae are reduced in number; there are few (5 to 6) in anteriormost parapodia (5 in the third foot), and they decrease gradually in number to the twelfth segment, where only an aciculum is present. Notosetae, where present, are short, stout, finely pectinated, with tip entire (fig. 39, *e*). Dorsal cirri are unusually elongate beyond the bulbous region (fig. 39, *d*). The acicular lobes of notopodia and neuropodia are produced, but the acicula do not extend beyond the fleshy lobes.

Genus SCALISETOSUS McIntosh

SCALISETOSUS FORMOSUS Moore

FIGURE 39, *c*

Scalisetosus formosus MOORE, 1903, p. 403 (U.S.N.M. no. 16165, Japan).

It is likely that *S. formosus* and *S. praelongus* Marenzeller (1902, p. 575), from south Japan, are identical. The parapodial and setal outlines are similar except that in *S. formosus* the neuroacicular lobes are somewhat spatulate distally (fig. 39, *c*) and seemingly tapering in *S. praelongus*. Ventral cirri in both are short, inserted proximally on the foot (fig. 39 *c*).

Genus INTOSHELLA Darboux

INTOSHELLA COECA (Moore), new combination

Harmothoë (*Eunoë*) *coeca* MOORE, 1910, p. 338 (U.S.N.M. no. 17476, California).

The type has two pairs of eyes faintly discernible, an anterior pair at the lateral margins where the prostomium is widest and a posterior pair near the posterior margin of the prostomium. All are pale, small, and about equal in size.

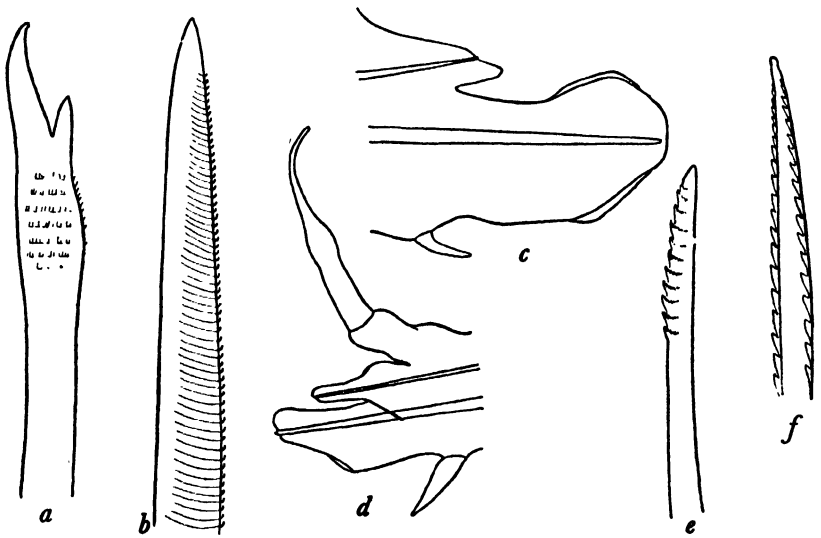


FIGURE 39.—Species of HARMOTHOË, SCALISETOSUS, ENIPO, and MACELLICEPHALA

a, b, Harmothoë trimaculata (Treadwell): *a*, Inferiormost neuropodial seta from twelfth parapodium, × 245; *b*, one of the stouter notopodial setae from twelfth parapodium, × 245.

c, Scalisetosus formosus Moore: Parapodium, probably from median part of body, in anterior view, × 38.

d, e, Enipo cirrata Treadwell: *d*, Third parapodium in posterior view, × 38; *e*, notopodial seta from third parapodium, × 245.

f, Macellicephala aciculata (Moore): Notopodial seta, × 245.

The genus *Intoshella* has been known for only one species, *I. euplectellae* McIntosh (1885, p. 108) from the Philippine Islands. From that species *I. coeca* differs in the shape of the prostomium and in having the palpi long, tapering, about twice as long as the lateral antennae, and much thicker. *I. coeca* is about 40 mm long; *I. euplectellae* is only about half that long.

Genus MALMGRENIA McIntosh

MALMGRENIA NESIOTES (Chamberlin), new combination

Polynoë nesiotes CHAMBERLIN, 1919a, p. 72 (U.S.N.M. no. 19460, Lower California).

The type has the following characters, which agree with the genus *Malmgrenia:* Lateral antennae are inserted terminally and they are smaller than the median antenna; there are 15 pairs of scales, covering the dorsum; there are only 34 segments, but the type is in two pieces, and may be incomplete in the midregion. Chamberlin's description is as complete as is possible with the material.

Genus MACELLICEPHALA McIntosh

MACELLICEPHALA REMIGATA (Moore), new combination

Polynoë (*?*) *remigata* MOORE, 1910, p. 365 (U.S.N.M. no. 17220, California).

This species, like the one following, consists of 18 setigerous segments. The prostomium consists of a pair of subglobular lobes, the posterior margin more or less flattened, the dorsoanterior margins each with a minute, papillar, prostomial peak. Lateral antennae are probably absent. Moore (1910, p. 365) mentions the swellings just ventral to the prostomial peaks and says that they "probably represent the bases of the lateral tentacles." They seem, more likely, however, to be fleshy swellings which never had attached antennae.

Neuropodial setae are serrated along one margin only, as in *M. mirabilis* McIntosh. It is likely that *M. remigata* and *M. mirabilis* are identical. The latter has been widely reported (New Zealand, north Atlantic, south Pacific, Hawaiian Islands, etc.). *M. remigata* was dredged off Santa Catalina Island.

MACELLICEPHALA (?) ACICULATA (Moore), new combination

FIGURE 39, *f*

Polynoë (*?*) *aciculata* MOORE, 1910, p. 367 (U.S.N.M. no. 17405, California).

The single type specimen is considerably macerated. It consists of 18 setigerous segments; the prostomium is strongly bilobed, with a pronounced median fissure. Eyes are lacking, and no trace of lateral antennae can be made out. The notopodium is greatly reduced and the few small dorsal setae are smooth. Neuropodial setae are long, flattened, transparent, and serrated along two sides (fig. 39, *f*).

Genus ADMETELLA McIntosh

ADMETELLA RENOTUBULATA (Moore), new combination

Polynoë (?) *renotubulata* MOORE, 1910, p. 368 (U.S.N.M. no. 16878, California).

Moore has already indicated the relation of this species with those of the genus *Admetella*. The type is notably smaller than those of two other species in the collections of the Museum, *A. dolichopus* and *A. hastigerens* Chamberlin. Also, it has only 35 segments and 14 pairs of scales as against the 60–75 segments and 23–30 pairs of scales usually present. Moore's type may possibly represent an immature specimen.

Genus Indeterminable

Polynoë (?) *filamentosa* Moore (1910, p. 366, U.S.N.M. no. 17221), from California, is unique in its parapodial structures. The notopodium is well developed; notopodial setae are pale amber, heavier than the neuropodials and some quite as long. Neuropodial setae are flat, thin, transparent, somewhat resembling those in *Macellicephala*. The prostomium is more than twice as broad as long, and apparently without eyes. The median ceratophore is stout, produced between the prostomial lobes and extends distally to the ends of the tiny papillalike prostomial peaks. The single type is fragmentary and does not permit a complete description.

Polynoë innatans Chamberlin (1919a, p. 70, U.S.N.M. no. 19459), from near the Galapagos Islands, is perhaps a species of *Eucranta* Malmgren. It is tiny, only 9.5 mm long, translucent, and without indication of sexual products; thus it may be an immature pelagic stage. The type resembles *Eucranta* as defined by Monro (1936, p. 100) in that (1) the notopodial setae are stouter than the neuropodials, (2) the neurosetae are of two kinds, both bidentate distally, and (3) the superior neuropodial setae are long, slender, pectinated, the inferior are stouter, shorter. The prostomium is harmothoid. There are only 26 setigerous segments and 11 (or possibly 12) elytrophores.

Family POLYODONTIDAE

Genus EUPANTHALIS McIntosh

EUPANTHALIS MUTILATA (Treadwell), new combination

FIGURES 40, *a–f*

Polynoë mutilata TREADWELL, 1906, p. 1152 (U.S.N.M. no. 5204, Hawaiian Islands).
? Eupanthalis oahuensis TREADWELL, 1906, p. 1155 (Hawaiian Islands).

I have not seen the type of *Eupanthalis oahuensis*. There is no record of the deposition of this type in the National collections.

The following description is based on the type of *P. mutilata*. The specimen consists of head and 78 segments, in two pieces. The head

is macerated; the posterior end is lacking. Setae are of four kinds as characteristic of the genus *Eupanthalis*, a typical parapodium has 5 to 12 geniculate pointed setae (fig. 40, *a*) in the ventralmost part of the fascicle, about 10 spinelike aristate setae (fig. 40, *d*), 1 or 2 penicillate setae (fig. 40, *c*), and a few fine capillary setae (fig. 40, *b*) in the superiormost part of a fascicle. The notopodium has a slender aciculum.

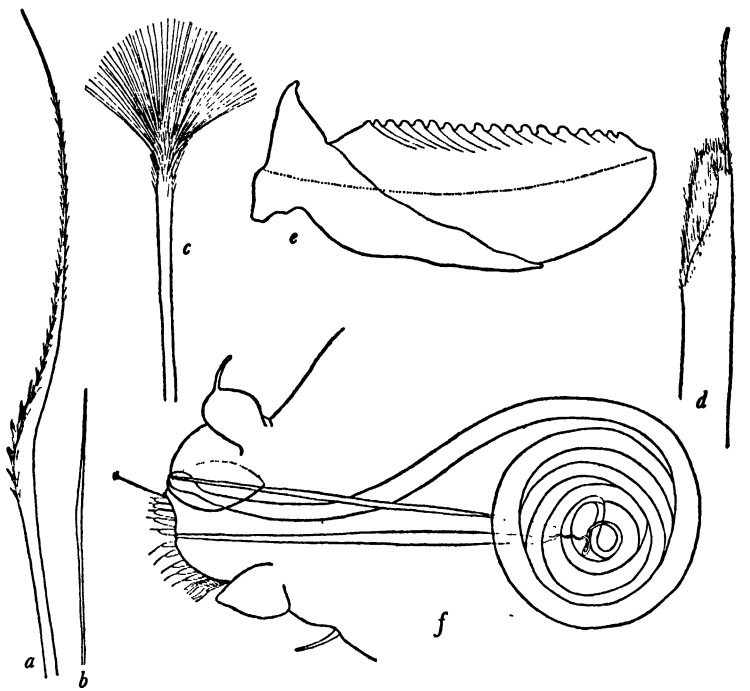


FIGURE 40.—EUPANTHALIS MUTILATA (Treadwell)

a, Inferior pointed neuroseta, × 294; *b*, superiormost seta, × 294; *c*, bushy-topped seta, × 294; *d*, tip of acicular, bayonet seta, × 294; *e*, lower right jaw piece from inner side, × 50; *f*, tenth parapodium with parapodial cord turned to the side, setae diagrammatically indicated, × 45.

The parapodial cord is a long, brown, stiff structure, terminating at its proximal end in a coil of four or five turns within the body wall (fig. 40, *f*). The four jaws are similar, the lower pieces each with about 18 low, lateral teeth in addition to the main fang (fig. 40, *e*). Elytra are pale, translucent, smooth. They are orbicular along their anterior and median sides, but along their posterolateral margin they are turned up so as to form a pouch, open dorsally.

Polynoë mutilata was taken from the same station, at the same time, as was *Eupanthalis oahuensis*. The two appear to be identical. The former name is being retained because its type is extant.

EUPANTHALIS MACULOSA (Treadwell), new combination

Macellicephala maculosa TREADWELL, 1931, p. 313 (U.S.N.M. no. 19543, Philippine Islands).

The type is a fragment of 64 segments; a posterior piece is lacking. Its setal, prostomial, and parapodial structures align it with the Polyodontidae. The body is long, vermiform. Eyes are sessile; lateral antennae are inserted terminally, and the median antenna is near the posterior margin of the prostomium. Parapodia are provided with glandular fibers. In these respects it agrees with *Eupanthalis*.

Genus POLYODONTES Renier

POLYODONTES OCULEA (Treadwell)

Panthalis oculea TREADWELL, 1902, p. 188 (U.S.N.M. no. 15961, West Indies). *Polyodontes oculea* MONRO, 1928, p. 572.

This species has been redescribed and assigned to this genus by Monro. Treadwell's illustration of the length of lateral prostomial antennae is practically as in the specimen; hence these appendages are notably longer than those in Monro's specimens. The absence of penicillate setae and the presence of a prostomial caruncle are characteristic of the type.

Genus EUPOLYODONTES Buchanan

EUPOLYODONTES ELONGATA (Treadwell), new combination

FIGURE 41, *a–d*

Iphionella elongata, TREADWELL, 1931, p. 315 (U.S.N.M. no. 19544, Philippine Islands).

The prostomium consists of two rounded lobes separated by a median depression. Each half has a large anterior eye directed anteriorly and a smaller dorsolateral eye on the posterior half of the lobe (fig. 41, *a*). Paired antennae are inserted terminally; they are long, slender, with a slight subterminal enlargement (fig. 41, *a*). No nuchal tentacle or papilla has been distinguished. First segment (peristomial) is apparently without setae.

Elytra are broadly orbicular, with a shallow indentation near the anteroectal margin; the margin is entire but slightly ruffled along the median or also the outer edges; the point of insertion is far to the side (fig. 41, *b*). Elytrophores are present as follows: On 2 (first setigerous segment), 4, 5, 7, 9, . . . and on all alternate segments at least to 43.

The lateral extensions of the jaw pieces have teeth as follows: 4 above and 5 below on the right side, and 5 above and 4 below on the left side. Setae are of 3 kinds (description based on a 10th parapodium); A superior fan-shaped fascicle of 30–35 long, pointed serrulated setae and a similar fascicle in the inferior part of the neuropodium, (2) an anterior fan-shaped fascicle of finer, shorter bristled capillaries (fig. 41, *d*) in front of the serrulated setae, and (3) about 8 stout, aristate spines (fig. 41, *c*) in a posterior series. No plumose setae have been observed.

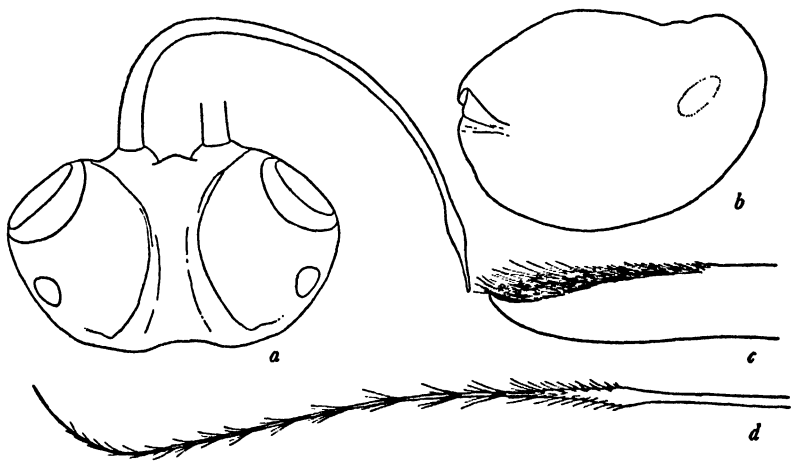


FIGURE 41.—EUPOLYODONTES ELONGATA (Treadwell)

a, Prostomium in dorsal view with left lateral antenna turned unnaturally to right, × 45; *b*, eleventh right elytron in dorsal view, elytral scar indicated in dotted outline, × 28; *c*, tip of stout aristate seta from tenth parapodium, the distal style probably lost, × 294; *d*, tip of slender capillary seta in anterior fascicle from tenth parapodium, × 294.

Genus PANTHALIS Kinberg

PANTHALIS ADUMBRATA Hoagland

Panthalis adumbrata HOAGLAND, 1920, p. 606 (U.S.N.M. no. 18944, Philippine Islands).

Panthalis helleri HOLLY, 1934, p. 148 (Philippine Islands).

The description of *P. helleri* compares favorably with that of *P. adumbrata.* Holly has given good illustrations of the characteristic elytra as well as the setae.

PANTHALIS PANAMENSIS Chamberlin

Panthalis panamensis CHAMBERLIN, 1919, p. 86 (U.S.N.M. no. 19431, Panama).

This species resembles *P. adumbrata* in having stalked ommatophores. It is smaller, however, probably less than 50 mm long; the elytra lack the black edges, and the prostomium is widest in the

posterior half instead of having its sides almost parallel as in *P. adumbrata.* The jaw pieces of *P. panamensis* have 5 erect lateral teeth, those of *P. adumbrata* have 7 blunt teeth.

PANTHALIS EVANIDA (Treadwell), new combination

Eupanthalis evanida TREADWELL, 1926, p. 186 (U.S.N.M. no. 19208, Philippine Islands).

This species has globular ommatophores as characteristic of the genus *Panthalis.* Parapodial glands are present from the eighth setigerous segment as in *P. oerstedi* Kinberg. The two may be identical.

Family APHRODITIDAE

Genus HERMIONE Blainville

HERMIONE TROPICUS (Treadwell), new combination

Melaenis tropicus TREADWELL, 1934, p. 1 (U.S.N.M. no. 20031, Virgin Islands).

This was originally described as a polynoid, but the type has the characteristic features of the genus *Hermione*, of the family Aphroditidae. It is colorless except for the pale amber, stout spines. There are 15 pairs of soft, imbricated scales; ventral setae are distally falcate, laterally with a few stout teeth; notopodial setae include some barbed, arrow-headed. The prostomium has a single median antenna and a pair of anterior peduncled eyes. These are indicated in the original figure as the bases of a pair of lateral tentacles.

LIST OF TYPES OF POLYNOIDAE AND POLYODONTIDAE IN THE UNITED STATES NATIONAL MUSEUM, WITH CHANGES OF NAME AND NEW COMBINATIONS

(Bibliographic source, Museum catalogue number, and type locality are given for ready reference. Synonyms are enclosed in brackets. Species discussed in the first part of this paper are followed by an asterisk.)

Admetella dolichopus CHAMBERLIN (1919a, p. 67, pl. 10, fig. 1; U.S.N.M. no. 19325; western Mexico).

Admetella hastigerens Chamberlin (1919a, p. 64, pl. 9, figs. 6-8; U.S.N.M. no. 19326; Central America).

Admetella renotubulata, new combination, for *Polynoë renotubulata* Moore.*

Antinoë anoculata MOORE (1910, p. 358, pl. 30, figs. 34–40; U.S.N.M. no. 16882; California).

Antinoë macrolepidia MOORE (1905, p. 538, pl. 35, figs. 21–23; U.S.N.M. no. 5509; Alaska).

Arctonoë tuberculata, new combination, for *Harmothoë tuberculata* Treadwell.*

Enipo cirrata TREADWELL (1925, p. 1, figs. 1–4; U.S.N.M. no. 19139; Alaska).*

Enipo gracilis VERRILL (1874, p. 407, pl. 5, fig. 3; Maine).

Eunoë (?) *crassa*, new combination, for *Lagisca crassa* Treadwell.*

Eunoë depressa MOORE (1905, p. 536, pl. 34, figs. 17, 18; pl. 35, figs. 19, 20; U.S.N.M. no. 5590; Alaska).

Eunoë cura CHAMBERLIN (1919a, p. 58, pl. 3, figs. 2–6; U.S.N.M. no. 19355; Peru).*

[*Eunoë exoculata* TREADWELL] (1923, p. 4, figs. 1–4; U.S.N.M. no. 19148; Lower California). See *Harmothoë tenebricosa.**

Eunoë spinulosa VERRILL (1879, p. 169; U.S.N.M. no. 7758; Nova Scotia).

[*Eupanthalis evanida* TREADWELL] (1926, p. 186, figs. 6–12; U.S.N.M. no. 19208). See *Panthalis evanida.**

Eupanthalis mutilata, new combination, for *Polynoë mutilata* Treadwell.*

Euphione chitoniformis (MOORE); includes *Lepidonotus chitoniformis* and possibly *L. branchiferus* Moore.*

Eupolyodontes elongata, new combination, for *Iphionella elongata* Treadwell.*

[*Evarnella trimaculata* TREADWELL] (1924, p. 6, figs. 1–3; U.S.N.M. no. 20326; Barbados). See *Harmothoë trimaculata.**

Gattyana scnta MOORE (1902, p. 259, pl. 13, figs. 1–13; U.S.N.M. no. 5598; Alaska).

[*Halosydna fusca-maculata* TREADWELL] (1924, p. 5, figs. 5–9; U.S.N.M. no. 20330; Barbados). See *Halosydnella fusca-maculata.**

[*Halosydna fuscomarginata* TREADWELL] (1924, in explanation of figures). See *Halosydnella fusca-maculata.**

[*Halosydna grisea* TREADWELL] (1929, p. 1, figs. 1–6; U.S.N.M. no. 19279; Argentina). See *Halosydnella grisea.**

Halosydna nebulosa GRUBE (1877, p. 49; China); includes *Halosydna vexillarius* Moore (see Seidler, 1924, p. 110).

[*Halosydna vexillarius* MOORE] (1903, p. 415, pl. 23, figs. 13–15; U.S.N.M. no. 15730; Japan). See *Halosydna nebulosa.*

Halosydnella fusca-marginata, new combination, for *Halosydna fusca-marginata* Treadwell.*

Halosydnella grisea, new combination, for *Halosydna grisea* Treadwell.*

Halosydnella oculata, new combination, for *Halosydna oculata* Treadwell.*

Harmopsides natans CHAMBERLIN (1919a, p. 48, pl. 6, figs. 1–5; U.S.N.M. no. 19720; Peru).

Harmothoë aculeata ANDREWS (1891, p. 278, pl. 12, figs. 1–5; U.S.N.M. no. 4876; North Carolina).

[*Harmothoë* (*Eunoë*) *coeca* MOORE] (1910, p. 338, pl. 28, figs. 7–12; U.S.N.M. no. 17476; California). See *Intoshella coeca.**

Harmothoë (*Evarne*) *fragilis* MOORE (1910, p. 353, pl. 29, figs. 29, 30; pl. 30, figs. 31–33; U.S.N.M. no. 17147; California).

[*Harmothoë levis* TREADWELL] (1937a, p. 26, figs. 1–5; U.S.N.M. no. 20222; Greenland). See *Harmothoë imbricata.**

Harmothoë mexicana CHAMBERLIN (1919a, p. 54, pl. 1, figs. 1–9; pl. 2, fig. 1; U.S.N.M. no. 19370; western Mexico).

Harmothoë scriptoria MOORE (1910, p. 344, pl. 28, figs. 13–17; U.S.N.M. no. 17156; California).

Harmothoë tenebricosa MOORE (1910, p. 351, pl. 29, figs. 23–28; U.S.N.M. no. 16877; California).*

Harmothoë triannulata MOORE (1910, p. 346, pl. 29, figs. 18–22; U.S.N.M. no. 17154; California).

Harmothoë trimaculata, new combination, for *Evarnella trimaculata* Treadwell.*

[*Harmothoë tuberculata* TREADWELL] (1906, p. 1154; U.S.N.M. no. 5205; Hawaiian Islands). See *Arctonoë tuberculata.**

Harmothoë villosa TREADWELL (1926, p. 10, pl. 2, figs. 14–18; U.S.N.M. no. 19190; Samoa).*

Hololepida magna MOORE (1905, p. 541, pl. 35, figs. 24–29; U.S.N.M. no. 5521; Alaska).

[*Hylosynda carinata* MOORE] (1903, p. 417; pl. 23, figs. 16, 17; U.S.N.M. no. 15732; Japan). See *Hyperhalosydna striata.**

Hyperhalosydna striata (KINBERG) (1855, p. 384; Australia); includes *Hylosynda carinata* Moore.*

Intoshella cocca, new combination, for *Harmothoë* (*Eunoë*) *cocca* Moore.*

Iphione fustis HOAGLAND (1920, p. 605, pl. 46, figs. 4–8; U.S.N.M. no. 18941; Philippine Islands).*

[*Iphionella elongata* TREADWELL] (1931, p. 315, fig. 2; U.S.N.M. no. 19544; Philippine Islands). See *Eupolyodontes elongata.**

[*Lagisca crassa* TREADWELL] (1924, p. 1, figs. 1–4; U.S.N.M. no. 19101; Chile). See *Eunoë crassa.**

Lagisca impatiens WEBSTER (1879b, p. 102, pl. 1, figs. 1–7; U.S.N.M. no. 500; New Jersey).

Lagisca irritans MARENZELLER (1904, p. 92, pl. 1; U.S.N.M. no. 5231; mid-Pacific).

Lagisca lamellifera (MARENZELLER) (1879, p. 115, pl. 1, fig. 5; Japan); includes *Lagisca multisetosa papillata* Moore (see Moore, 1910, p. 341).

[*Lagisca multisetosa papillata* MOORE] (1908, p. 335; U.S.N.M. no. 5642; Alaska). See *Lagisca lamellifera.*

Lepidametria commensalis WEBSTER (1879a, p. 210, pl. 3, figs. 23–31; U.S.N.M. no. 521; Virginia).

Lepidasthenia alba, new combination, for *Polynoë alba* Treadwell.*

Lepidasthenia curta CHAMBERLIN (1919a, p. 61, pl. 5, figs. 4–9; U.S.N.M. no. 19399; western Mexico).

Lepidasthenia interrupta (MARENZELLER) (1902, p. 570, pl. 1, fig. 2; Japan); includes *Polynoë semicrma* Moore and *Lepidasthenia ocellata* Treadwell.*

Lepidasthenia lucida, new combination, for *Polynoë lucida* Treadwell.*

[*Lepidasthenia ocellata* TREADWELL] (1936, p. 264, fig. 18; U.S.N.M. no. 20113; China). See *L. interrupta.**

[*Lepidonotus branchiferus* MOORE] (1903, p. 409, pl. 23, figs. 7–9; U.S.N.M. no. 15721; Japan). See *Euphione chitoniformis.**

Lepidonotus caelorus MOORE (1903, p. 412, pl. 23, fig. 13; U.S.N.M. no. 15733; Japan); includes *Polynoë spicula, Lepidonotus minutus,* and possibly *L. castriensis* Seidler.*

[*Lepidonotus chitoniformis* MOORE] (1903, p. 405, pl. 23, figs. 10, 11; U.S.N.M. no. 15646; Japan). See *Euphione chitoniformis.**

Lepidonotus helotypus GRUBE (1877, p. 49; China); includes *L. robustus* MOORE.*

[*Lepidonotus minutus* TREADWELL] (1936, p. 262, fig. 18; U.S.N.M. no. 20112; China). See *L. caelorus.**

Lepidonotus nesophilus CHAMBERLIN (1919a, p. 75, pl. 4, figs. 1–7; pl. 5, fig. 13; U.S.N.M. no. 19400; Galapagos Island).

[*Lepidonotus robustus* MOORE] (1905, p. 544, pl. 36, figs. 32–35; U.S.N.M. no. 5523; Alaska). See *L. helotypus.**

Lepidonotus variabilis WEBSTER (1879, p. 205; pl. 1, figs. 6–11; pl. 2, figs. 12–14; U.S.N.M. no. 431; Virginia).

Macellicephala (?) *aciculata,* new combination, for *Polynoë aciculata* Moore.*

[*Macellicephala maculosa* TREADWELL] (1931, p. 313, fig. 1; U.S.N.M. 19543; Philippine Islands). See *Eupanthalis maculosa.**

Macellicephala remigata, new combination, for *Polynoë remigata* Moore.*

Malmgrenia nesiotes, new combination, for *Polynoë nesiotes* Chamberlin.*

[*Melaenis tropicus* TREADWELL] (1934, p. 1, pl. 1, figs. 1–6; U.S.N.M. no. 20031; Virgin Islands). See *Hermione tropicus.**

Nemidia microlepida MOORE (1910, p. 362, pl. 30, figs. 42–44, pl. 31, figs. 45, 46; U.S.N.M. no. 17113; California).

Panthalis adumbrata HOAGLAND (1920, p. 606, pl. 46, figs. 9–14; U.S.N.M. no. 18944; Philippine Islands).*

Panthalis evanida, new combination, for *Eupanthalis evanida* Treadwell.*

[*Panthalis oculea* TREADWELL] (1902, p. 188, figs. 14–18; U.S.N.M. no. 15961; Porto Rico). See *Polyodontes oculea.**

Panthalis panamensis CHAMBERLIN (1919a, p. 86, pl. 11, figs. 4–8; U.S.N.M. no. 19431; Panama).*

Plotolepis nans CHAMBERLIN (1919a, p. 40, pl. 7, figs. 3, 4; U.S.N.M. no. 19453; Easter Islands).

Podarmus ploa CHAMBERLIN (1919a, p. 45, pl. 6, fig. 6, pl. 7, figs. 1, 2; U.S.N.M. no. 19458; Easter Island).

[*Polynoë aciculata* MOORE] (1910, p. 367, pl. 31, figs. 57, 58; U.S.N.M. no. 17405; California). See *Macellicephala* (?) *aciculata.**

[*Polynoë alba* TREADWELL] (1906, p. 1149, figs. 4–6; U.S.N.M. no. 5201; Hawaiian Islands). See *Lepidasthenia alba.**

[*Polynoë branchiata* TREADWELL] (1902, p. 186, figs. 5–7; U.S.N.M. 16006; Porto Rico) is identical with *Chaetacanthus magnificus* (Grube) (see Seidler, 1924, p. 97).

Polynoë (?) *filamentosa* MOORE (1910, p. 366, pl. 31, figs. 52–56; U.S.N.M. no. 17221; California).*

Polynoë (?) *innatans* CHAMBERLIN (1919a, p. 70, pl. 8, figs. 1–7; U.S.N.M. no. 19459; near the Galapagos Islands).*

[*Polynoë lucida* TREADWELL] (1906, p. 1150, figs. 8–10; U.S.N.M. no. 5202; Hawaiian Islands). See *Lepidasthenia lucida.**

[*Polynoë mutilata* TREADWELL] (1906, p. 1152, figs. 12–15; U.S.N.M. no. 5204; Hawaiian Islands). See *Eupanthalis mutilata.**

[*Polynoë nesiotes* CHAMBERLIN] (1919a, p. 72, pl. 8, fig. 8, pl. 9, figs. 1–5; U.S.N.M. no. 19460; Lower California). See *Malmgrenia nesiotes.**

[*Polynoë nodosa* TREADWELL] (1902, p. 187, figs. 8, 9; U.S.N.M. no. 16014; Porto Rico) is identical with *Hermenia verruculosa* (Grube) (see Augener, 1925, p. 4, for synonymy).

[*Polynoë remigata* MOORE] (1910, p. 365, pl. 31, figs. 47–51; U.S.N.M. no. 17220; California). See *Macellicephala remigata.**

[*Polynoë renotubulata* MOORE] (1910, p. 368, pl. 31, figs. 59–64; U.S.N.M. no. 16878; California). See *Admetella renotubulata.**

[*Polynoë semierma* MOORE] (1903, p. 402; pl. 23, figs. 2, 3; U.S.N.M. no. 15738; Japan). See *Lepidasthenia interrupta.**

[*Polynoë spicula* TREADWELL] (1906, p. 1151, fig. 11; U.S.N.M. no. 5203; California). See *Lepidonotus caelorus.**

Scalisetosus formosus MOORE (1903, p. 403, pl. 23, figs. 4–6; U.S.N.M. no. 16165; Japan).*

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REVIEW OF THE FISHES OF THE GENERA POLYIPNUS AND ARGYROPELECUS (FAMILY STERNOPTICHIDAE),[1] WITH DESCRIPTIONS OF THREE NEW SPECIES

By LEONARD P. SCHULTZ

THIS study is based on the specimens of fishes of the family Sternoptichidae in the genera *Polyipnus* and *Argyropelecus* in the collections of the United States National Museum. The term length herein refers to the standard length, or the distance from the tip of the snout to the base of the midcaudal fin rays. In the literature cited in synonymy, all publications have been examined except papers by those authors whose names are preceded by an asterisk (*).

Drawings for the figures, except figure 42, were made by Jane Roller.

Genus POLYIPNUS Günther

Polyipnus GÜNTHER, *Challenger* Reports, vol. 22, pt. 57, p. 170, 1887 (*P. spinosus* Günther).

Acanthopolyipnus (subg.) FOWLER, Proc. Acad. Nat. Sci. Philadelphia, vol. 85, p. 257, 1934 (*Polyipnus fraseri* Fowler).

This genus may be recognized by the following characters: A pair of diverging spines just in front of the origin of the soft dorsal fin; the absence of a dorsal blade; ten abdominal photophores; three supra-abdominal photophores; a lateral photophore; three suprapectoral photophores; anal fin undivided.

Figure 42 shows diagrammatically the positions and names of the various series of photophores as used in this paper.

[1] See Gill, 1884, for early history of names in references to this family.

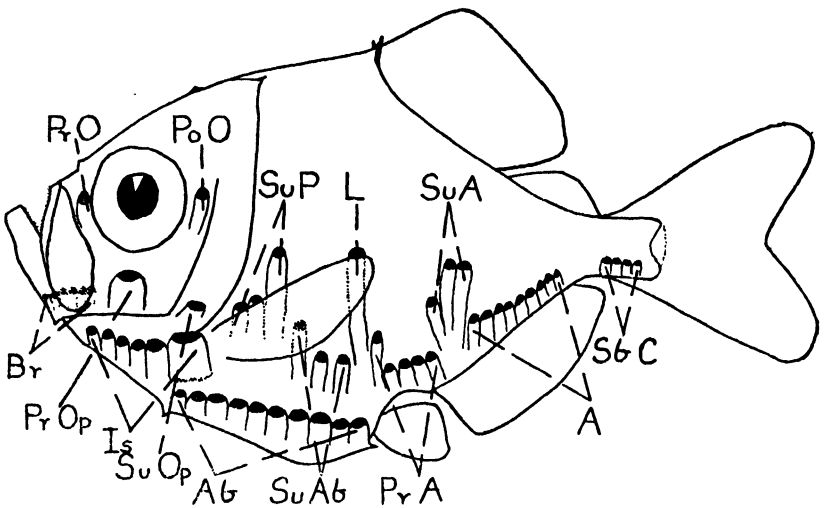


FIGURE 42.—Diagrammatic sketch of *Polyipnus* showing the names applied to the various series of photophores found in *Argyropelecus* and *Polyipnus* as used in this paper: *A*, Anal organs; *Ab*, abdominal organs; *Br*, branchiostegal organs; *Is*, organs on isthmus; *L*, lateral organ; *PoO*, postorbital organ; *PrA*, preanal organs; *PrO*, preorbital organ; *PrOp*, preopercular organ; *SbC*, subcaudal organs; *SuA*, supra-anal organs; *SuAb*, supra-abdominal organs; *SuOp*, subopercular organ; *SuP*, suprapectoral organs.

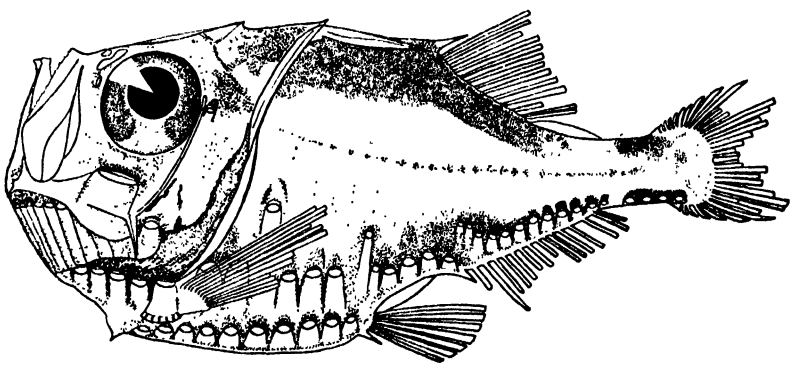


FIGURE 43.—*Polyipnus unispinus*, new species: Holotype (U. S. N. M. no. 103153).

POLYIPNUS UNISPINUS, new species

FIGURE 43

Holotype.—U.S.N.M. no. 103153, 20.5 mm in standard length, *Albatross* station 5451, latitude 13°22′22″ N., longitude 124°00′48″ E., depth 380 fathoms, June 5, 1909.

Paratypes.—Five specimens from the same collection, U.S.N.M. no. 103029, 16 to 19 mm.

Description.—The description is based on the holotype and the five paratypes. The counts and measurements given outside the parentheses were taken from the holotype, and those inside the parentheses were taken from the 5 paratypes, respectively. All measurements are expressed in hundredths of the standard length. The dorsal fin is preceded by a pair of short diverging spines, the number of dorsal soft rays are 12 (11, 12, 11, 12, 12); anal rays 14 (13, 14, 13, 14, 13); pelvic fin rays 7 (probably always 7); pectoral rays 12 (13, —, 13, 15, 13); gill rakers on anterior margin of first gill arch 4+8 (4+7, 4+7, 4+8, 4+7, 4+7); abdominal plates always 10. The lanterns (fig. 42) always occur in pairs on holotype and paratypes in the following numbers: Branchiostegals always 6; isthmus always 6; abdominals always 10; anals 12 (11, 13, 11, 11, 11), the first two or three are much smaller than those that follow and usually a trifle above the posterior ones; preanals always 5, the first usually smaller than the 4 posterior ones; suprapectorals always 3; subcaudals always 4; supra-abdominals always 3; preorbital always 1; subopercular always 1; lateral organ always 1, this is a small photophore lying above the first preanal organ. Length of head 31.6 (32.6, 30.3, 31.6, 30.6, 31.2); length of snout 7.8 (8.6, 8.3, 7.9, 7.1, 8.7); width of bony interorbital 5.9 (5.7, 5.6, 5.3, 5.9, 6.2); horizontal diameter of eye 15.6 (17.2, 16.7, 15.8, 17.7, 16.9); length from tip of snout to rear margin of maxillary 21.0 (24.2, 23.4, 22.6, 21.2, 21.9); length from snout to origin of soft dorsal 56.2 (57.2, 55.6, 60.5, 54.7, 52.0); greatest depth of body 48.8 (51.5, 50.0, 48.4, 53.0, 50.0); least depth of caudal peduncle 10.3 (9.7, 11.1, 10.5, 11.2, 11.3); length of caudal peduncle 19.5 (17.2, 22.2, 21.2, 22.9, 18.8); length of longest gill raker on first gill arch 7.8 (8.6, 8.3, 7.9, 8.8, 7.5); length of abdomen 39.1 (34.3, 38.9, 33.2, 38.1, 34.4); distance from origin of soft dorsal to base of caudal fin rays 44.0 (45.7, 47.3, 47.4, 47.1, 43.7); length of the posttemporal (nuchal) process measured from nape to posterior tip of the spine 22.0 (24.0, 23.4, 21.2, 20.6, 21.9).

Remarks.—This new species differs from all other members of the genus *Polyipnus* that lack the supra-anal organs by the single posttemporal spine without serrations below and the fewer gill rakers, 4+7 or 8 instead of 7 to 10+12 to 18. The following synoptic key, based upon specimens in the United States National Museum,

should enable the reader to distinguish each species referred to the genus *Polyipnus*. Table 1 presents comparative data on the several species of the genus.

The name *unispinus* refers to the single long posttemporal spine.

TABLE 1.—*Counts made on various species of* Polyipnus

Species	Dorsal soft rays							Anal rays [1]							Pectoral rays			
	10	11	12	13	14	15	16	11	12	13	14	15	16	17	12	13	14	15
fraseri	1							1									1	
nuttingi			3	4								2	4	1	1	5		
unispinus		2	4							3	3				1	3		1
spinosus			1	6	1						1	4	5	1	1	3	2	2
asteroides				1	4	1								6			4	1
laternatus [2]					1								1					1
triphanos			3											3			2	

Species	Gill rakers on first gill arch																	
	4+7	4+8	5+9	5+10	5+11	7+12	7+13	7+14	7+15	7+16	7+17	8+14	8+15	8+16	8+17	9+17	9+18	10+17
fraseri						1												
nuttingi								1	1	2			3					
unispinus	4	2																
spinosus						1	1		1	1	1		2	1	1	1	1	1
asteroides								1		1			2	3				
laternatus [2]												1						
triphanos			1	1	3													

Species	Total gill rakers on first gill arch																Photophores in the anal series												
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	4	5	6	7	8	9	10	11	12	13	14	15
fraseri									1									1											
nuttingi											1	1	5												5	2			
unispinus	4	2																							4	1	1		
spinosus								1	1		1	3	2	1	1	2										1	4	3	2
asteroides											1		3	3								5							
laternatus [2]												1													1	2			
triphanos				1	1	3																1	2						

[1] All rudiments counted as one ray. [2] Data from Garman, 1899, and Parr, 1937.

POLYIPNUS ASTEROIDES, new species

FIGURE 44

Polyipnus laternatus NORMAN, *Discovery* Reports, vol. 2, p. 305, fig. 14, 1930.—JESPERSEN, *in* Joubin, Faune ichthyologique de l'Atlantique nord, No. 15, 1934.—FOWLER, Bull. Amer. Mus. Nat. Hist., vol. 70, no. 2, p. 1206, 1936.

Holotype.—U.S.N.M. no. 102979, 39.5 mm in standard length, First Johnson-Smithsonian Deep-sea Expedition, 1933, tin tag no.

440, station 81, latitude 18°29′45″ N., longitude 65°25′50″ W., to latitude 18°35′30″ N., longitude 65°23′54″ W., depth 200 to 400 fathoms, February 26, 1933.

Paratypes.—U.S.N.M. no. 102978, 4 specimens, lengths 26 to 39.5 mm, collected by the First Johnson–Smithsonian Deep-sea Expedition, 1933, tin tag no. 516, station 83, latitude 18°32′54″ N., longitude 65°23′42″ W., to latitude 18°32′15″ N., longitude 65°18′45″ W., depth 250 to 320 fathoms, February 26, 1933. U.S.N.M. no. 86131, length 20 mm, *Grampus* station 10482, Gulf of Mexico, depth 500 to 0 meters, March 23, 1917 (this specimen is in such poor condition that measurements and certain counts were not made).

Description.—The description is based on the holotype and the five paratypes. The counts and measurements given outside the parentheses were taken from the holotype and those inside the paren-

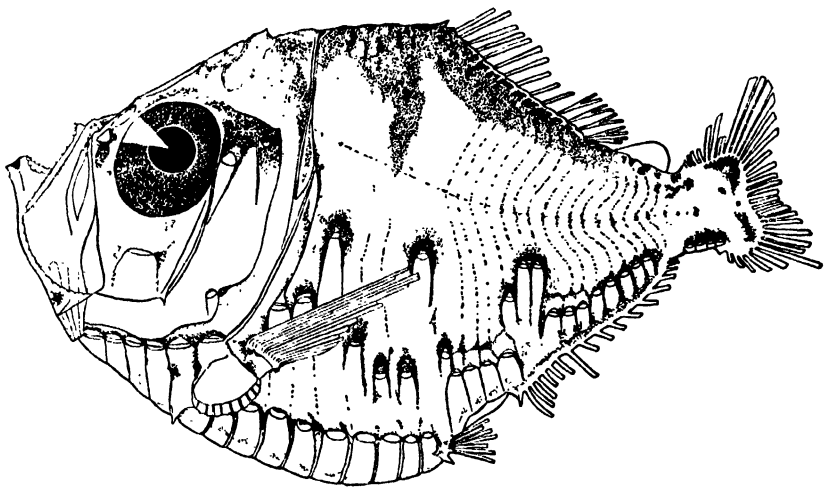


FIGURE 44.—*Polyipnus asteroides*, new species: Holotype (U.S.N.M. no. 102979).

theses, representing the minimum and maximum, were taken from the paratypes. All measurements are expressed in hundredths of the standard length. Standard lengths 39.5 (26 to 39.5 mm); the number of dorsal soft rays are 14 (12 to 15); anal rays 16 (17); pelvic fin rays 7 (7); pectoral fin rays 14 (14 to 15); gill rakers on anterior margin of first gill arch 8+16 (7+14 to 16−8+15 to 16); abdominal plates 10 (10).

The lanterns occur as follows: Branchiostegals always 6; isthmus always 6; abdominals always 10; anals 9 (9); preanals always 5; supra-anals always 3; suprapectorals always 3; subcaudals always 4; supra-abdominals always 3; preopercular, postorbital, preorbital, subopercular, and lateral organs always 1 each. Length of head 35.5 (34.2 to 35.5); length of snout 8.9 (8.7 to 9.3); width of bony

interorbital 6.3 (6.6 to 7.2); horizontal diameter of eye 16.4 (16.7 to 17.2); length from tip of snout to rear margin of maxillary 29.1 (29.0 to 30.4); length from tip of snout to origin of soft dorsal 55.8 (52.2 to 57.1); greatest depth of body 69.6 (72.2 to 77.8); least depth of caudal peduncle 11.6 (12.6 to 15.0); length of caudal peduncle, posterior base of anal to base of middle caudal rays, 11.9 (14.5 to 16.0); length of longest gill raker on first gill arch 10.1 (8.7 to 10.1); length of abdomen 39.3 (37.7 to 40.0); distance from origin of soft dorsal to base of caudal fin rays 49.4 (52.2 to 55.8); length of base of dorsal fin 28.4 (27.6 and 29.1).

Remarks.—This species differs from *laternatus* in the number of anal photophores, 9 instead of 11 or 12, and in their size and arrangement. If Parr's (1937, p. 56) figure 22 is correctly drawn, then the width of the first three is equal to the width of the last 5 or 6 anal organs in *laternatus*, but only equal to the last 3¾ to 4¼ in *asteroides* and *triphanos;* the first supra-abdominal photophore extends above the second organ a distance less than its width in *laternatus* but more than its width in *asteroides;* the third supra-abdominal organ is only slightly higher than the second, or is even with it.

The name *asteroides* refers to the starlike photophores.

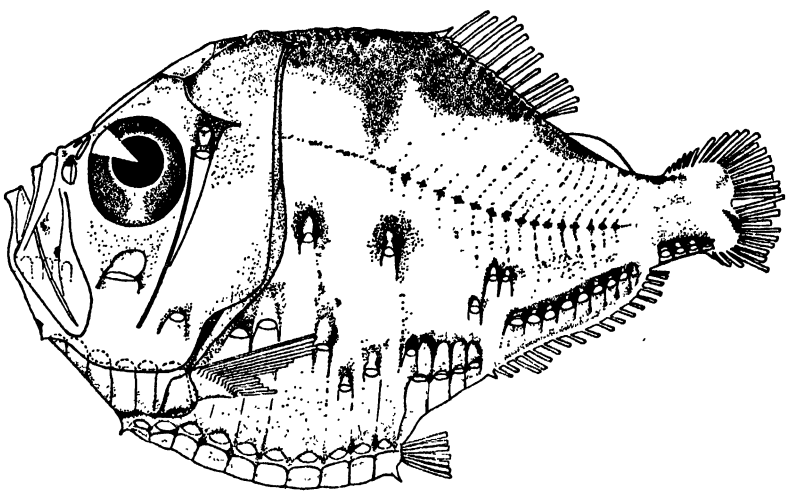


FIGURE 45.—*Polyipnus triphanos,* new species: Holotype (U.S.N.M. no. 103027).

POLYIPNUS TRIPHANOS, new species

FIGURE 45

Holotype.—U.S.N.M. no. 103027, 20 mm in standard length, *Albatross* station 5368, latitude 13°35′30″ N., longitude 121°48′ E., 181 fathoms, February 23, 1909.

Paratypes.—U.S.N.M. no. 103028, 2 specimens, 17.5 and 21.5 mm, *Albatross* station 5500, latitude 8°37′45″ N., longitude 124°36′45″ E., 267 fathoms, August 4, 1909.

Description.—The description is based on the holotype and the two paratypes. Counts and measurements made as in other two new species. Standard lengths 20 (17.5 and 21.5 mm); the number of dorsal soft rays are 12 (12 and 12); anal rays 17 (17); pelvic fin rays probably 7; pectoral fin rays 14 (14); gill rakers on anterior margin of first gill arch 5+9 and 5+10 (5+11); abdominal plates 10 (10). The lanterns occur as follows: Branchiostegals always 6; isthmus always 6; abdominals always 10; anals 9 (8 or 9), the last organ usually rudimentary and very small; preanals always 5; supra-anals always 3; suprapectorals always 3; subcaudals always 4; supra-abdominals always 3; preopercular, postorbital, preorbital, subopercular, and lateral organs always 1 each. Length of head 35 (33.5 and 34.3); length of snout 7.5 (6.9 and 7.9); width of bony interorbital 6.5 (5.7 and 7.0); horizontal diameter of eye 17.5 (16.3 and 17.1); length from tip of snout to rear margin of maxillary 29.0 (28.0 and 28.5); length from tip of snout to origin of soft dorsal 60.0 (52.3 and 57.2); greatest depth of body 70.0 (62.9 and 64.0); least depth of caudal peduncle 14.0 (11.6 and 12.0); length of caudal peduncle 13.0 (13.1 and 14.0); length of longest gill raker on first gill arch 10.0 (8.4 and 8.6); length of abdomen 42.0 (37.2); distance from origin of soft dorsal to base of caudal fin rays 54.0 (51.3 and 51.4); length of base of dorsal fin 20.0 (16.3 and 17.1).

Remarks.—This species differs from *laternatus* and *asteroides* in the number of gill rakers, 5+9 to 11 instead of 7 to 8+14 to 16, and in the size and arrangement of the photophores. The width of the first three anal organs in *triphanos* equals the width of the last 3½ to 4¼ organs, instead of 5 or 6 in *laternatus*. The second supra-abdominal photophore is not in line with the third but is below it a distance equal to its width, and the second is below the first a distance equal to 1½ to 2 times the width of the first.

The name *triphanos* refers to the characteristic position of the three supra-abdominal photophores.

SYNOPSIS OF THE SPECIES OF POLYIPNUS

a^1 Minute teeth present on vomer and palatines; posttemporal process of one main spine, which is smooth and shorter than diameter of eye, usually not longer than diameter of pupil; at anterior end of anal series of photophores are 3 supra-anal photophores located much above general line of anal organs.

b^1. Anal organs 11 or 12; gill rakers on first gill arch about 8+14; width of first 3 anal organs equal to width of last 5 or 6 anal organs; first and

third supra-abdominal organs nearly in line, second is slightly below them, the distance not more than half width of first. Range: Atlantic (West Indies)----------laternatus Garman, 1899

b^2. Anal organs 7 to 9.

c^1. Gill rakers on first gill arch 7 or 8+14 to 16; width of first 3 anal organs equal to width of last 3¾ to 4¼ anal organs; last or third supra-abdominal organ in line with middle organ or only slightly above it; first organ extends above second and third a distance equal to 1 or 1½ times its width. Range: Atlantic (Bahama Islands; Gulf of Mexico)----------asteroides, new species

c^2. Gill rakers on first gill arch 5+9 to 11; width of first 3 anal organs equals width of last 3½ to 4¼ anal organs; last or third supra-abdominal organ above middle organ by a distance equal to its width; first organ extends above second organ a distance equal to 1½ to 2 times its width. Range: Philippine Islands---------triphanos, new species

a^2. Minute teeth present on vomer but absent on palatines; at anterior end of anal series of photophores no organ is located high above general line of these organs.

d^1. Posttemporal process of 3 spines, the middle one variable in length and position, sometimes almost lacking but never longer than upper spine, upper spine usually almost straight, pointing backward, variable in length, often shorter than diameter of pupil or as long as diameter of eye, upper spine always longer than lower spine, the latter usually curved downward.

e^1. Anal photophores about 12 to 15 in adults; photophores along ventral margin of body usually without definite spaces between the various series in large adults, while in smaller fish, between anal and subcaudal series, there may be no space or space may equal width of 1 to 3 of subcaudal organs, depending on size of specimen. Range: Pacific (Japan; Philippines; Celebes Sea; Strait of Macassar; Great Australian Bight); Atlantic (Gulf of Guinea ?; Gulf of Mexico ?); Indian Ocean (Andaman Sea; Bay of Bengal)----------spinosus Günther, 1887

e^2. Anal photophores 4 in adults; photophores along ventral margin of body with a definite space between preanal and anal series and another space between anal and subcaudal series, both spaces equal to or greater than length of subcaudal series. Range: Philippine Islands----------fraseri Fowler, 1934

d^2. Posttemporal process of one main spine, which may be smooth or very rough, spiny, or toothed below.

f^1. Gill rakers on first arch 4+7 or 8; main spine of posttemporal process long and slender, without any trace of spine below it, length of this spine equal to or greater than diameter of pupil; space between anal and subcaudal series of organs less than width of 3 subcaudal organs; anal photophores about 11 to 13. Range: Philippine Islands.

unispinus, new species

f^2. Gill rakers 7 or 8+14 to 16; main spine of posttemporal process short and heavy, its length less than diameter of pupil; space between anal and subcaudal series of organs greater than width of 3 subcaudal organs; anal photophores about 11 or 12. Range: Pacific (Hawaiian Islands; south of Minamitori Shima, Marcus Islands).

nuttingi Gilbert, 1905

POLYIPNUS LATERNATUS Garman, 1899

Polyipnus laternatus GARMAN, Mem. Mus. Comp. Zool., vol. 24, p. 238, 1899.—?FRASER-BRUNNER, Ann. Mag. Nat. Hist., ser. 10, vol. 8, p. 218, 1931.—PARR, Bull. Bingham Oceanogr. Coll., vol. 3, no. 7, p. 55, fig. 22, 1937.

POLYIPNUS SPINOSUS Günther, 1887

Polyipnus spinosus GÜNTHER, *Challenger* Reports, vol. 22, p. 170, pl. 51, 1887 (depth 250 fathoms, station 200 between Philippine Islands and Borneo).—ALCOCK, Ann. Mag. Nat. Hist., ser. 6, vol. 4, p. 398, 1889.—WOOD-MASON and ALCOCK, Ann. Mag. Nat. Hist., ser. 6, vol. 8, p. 126, 1891.—GOODE and BEAN, Oceanic ichthyology, fig. 148 (reversed fig. of Günther's fig. of type), 1895.—ALCOCK, Journ. Asiat. Soc. Bengal, vol. 65, p. 331, 1896.—ALCOCK, A descriptive catalogue of the Indian deep-sea fishes in the Indian Museum, p. 138, 1899.—BRAUER, Tiefsee-Expedition . . . *Valdivia*, 1898–1899, vol. 15, p. 120, fig. 64 and figs. 65, 66 (?), 1906 (Gulf of Guinea).—WEBER and BEAUFORT, The fishes of the Indo-Australian Archipelago, vol. 2, p. 130, fig. 47, 1914.—NICHOLS and BREDER, Proc. Biol. Soc. Washington, vol. 37, p. 21, 1924 (*Grampus* station 10482, Gulf of Mexico, lat. 28°52′ N., long. 88°36′ W., depth 500 to 0 meters).—BARNARD, Ann. South African Mus., vol. 21, p. 155, 1925.—FOWLER, Bull. Amer. Mus. Nat. Hist., vol. 70, p. 240, fig. 112, 1936.—PARR, Bull. Bingham Oceanogr. Coll., vol. 3, no. 7, p. 55, 1937.

Polyipnus stereope JORDAN and STARKS, Bull. U. S. Fish Comm., vol. 22 (for 1902), p. 581, 1904 (type: U. S. N. M. no. 51451; *Albatross* station 3698, Sagami Bay, Japan).—JORDAN, TANAKA, and SNYDER, Journ. College Sci. Imp. Univ. Tokyo, vol. 33, no. 1, p. 52, fig. 30, 1913.

Polyipnus tridentifer MCCULLOCH, Biol. Results Fish Expt. F. I. S. *Endeavour*, 1909–1914, vol. 2, pt. 3, pp. 78, 87–89, pl. 16, 1914.

I have examined Jordan and Stark's type of *P. stereope* and found it to agree closely with a sketch of the posttemporal spine of Günther's type; the sketch was kindly furnished by J. R. Norman, of the British Museum.

The following specimens are in the collections of the United States National Museum: U.S.N.M. no. 44429, one specimen, length 43 mm, H. M. S. *Investigator*, Andaman Sea; and 52 specimens collected by the steamer *Albatross*, as follows:

U.S.N.M. no. 102980, 2 specimens, lengths 29 and 36 mm, station 4897, Goto Islands, latitude 32°33′ N., longitude 128°19′ E., depth 207 fathoms, August 10, 1906.

U.S.N.M. no. 102981, 2 specimens, 39 and 43 mm, station 4913, latitude 31°39′10″ N., longitude 129°22′30″ E., 391 fathoms, August 12, 1906.

U.S.N.M. no. 102982, 2 specimens, 52 and 55 mm, station 4967, latitude 33°25′10″ N., longitude 135°37′20″ E., 244 fathoms, August 29, 1906.

U.S.N.M. no. 103036, 2 specimens, 48 and 50 mm, station 5221, latitude 13°38′15″ N., longitude 121°48′15″ E., 193 fathoms, April 24, 1908.

U.S.N.M. no. 103039, 1 specimen, bad condition, station 5280, latitude 13°55′20″ N., longitude 120°25′55″ E., 193 fathoms, July 17, 1908.

U.S.N.M. no. 103032, 1 specimen, 49 mm, station 5113, latitude 13°51′30″ N., longitude 120°50′30″ E., 159 fathoms, January 17, 1908.

U.S.N.M. no. 103033, 1 specimen, 37 mm, station 5171, latitude 5°05′ N., longitude 119°28′ E., 250 fathoms, February 28, 1908.

U.S.N.M. no. 103034, 1 specimen, 44 mm, station 5179, latitude 12°38′15″ N., longitude 122°12′30″ E., 37 fathoms, April 9, 1908.

U.S.N.M. no. 103035, 1 specimen, 29 mm, station 5261, latitude 12°30′55″ N., longitude 121°34′24″ E., 56 fathoms, June 4, 1908.

U.S.N.M. no. 103038, 1 specimen, 48 mm, station 5270, latitude 13°35′45″ N., longitude 120°58′30″ E., 235 fathoms, June 8, 1908.

U.S.N.M. no. 103040, 1 specimen, 50 mm, station 5281, latitude 13°52′45″ N., longitude 120°25′ E., 201 fathoms, July 18, 1908.

U.S.N.M. no. 103041, 1 specimen, 44 mm, station 5291, latitude 13°29′40″ N., longitude 121°00′45″ E., 173 fathoms, July 23, 1908.

U.S.N.M. no. 103042, 1 specimen, 21 mm, station 5293, latitude 13°28′15″ N., longitude 121°04′30″ E., 180 fathoms, July 23, 1908.

U.S.N.M. no. 103043, 10 specimens, 10 to 56 mm, station 5363, latitude 13°47′20″ N., longitude 120°43′30″ E., 180 fathoms, February 20, 1909.

U.S.N.M. no. 103044, 1 specimen, 38 mm, station 5374, latitude 13°46′45″ N., longitude 121°35′08″ E., 180 fathoms, March 2, 1909.

U.S.N.M. no. 103045, 1 specimen, 54 mm, station 5388, latitude 12°51′30″ N., longitude 123°26′15″ E., 226 fathoms, March 11, 1909.

U.S.N.M. no. 103046, 3 specimens, 45 to 54 mm, station 5409, latitude 10°38′ N., longitude 124°13′08″ E., 385 fathoms, March 18, 1909.

U.S.N.M. no. 103047, 1 specimen, 42 mm, station 5419, latitude 9°58′30″ N., longitude 123°46′ E., 175 fathoms, March 25, 1909.

U.S.N.M. no. 103048, 1 specimen, 53 mm, station 5442, latitude 16°30′36″ N., longitude 120°11′06″ E., 45 fathoms, May 10, 1909.

U.S.N.M. no. 103049, 1 specimen, 45 mm, station 5503, latitude 8°36′26″ N., longitude 124°36′08″ E., 226 fathoms, August 4, 1909.

U.S.N.M. no. 103050, 1 specimen, 65 mm, station 5537, latitude 9°11′00″ N., longitude 123°23′00″ E., 254 fathoms, August 19, 1909.

U.S.N.M. no. 103051, 3 specimens, 45 to 59 mm, station 5538, latitude 9°08′15″ N., longitude 123°23′20″ E., 256 fathoms, August 19, 1909.

U.S.N.M. no. 103052, 3 specimens, 36 to 43 mm, station 5563, latitude 5°48′12″ N., longitude 120°30′48″ E., 224 fathoms, September 2, 1909.

U.S.N.M. no. 103053, 1 specimen, 34 mm, station 5569, latitude 5°33′15″ N., longitude 120°15′30″ E., 303 fathoms, September 22, 1909.

U.S.N.M. no. 103054, 1 specimen, 59 mm, station 5589, latitude 4°12′10″ N., longitude 118°38′08″ E., 260 fathoms, September 29, 1909.

U.S.N.M. no. 103055, 1 specimen, 63 mm, station 5590, latitude 4°10′50″ N., longitude 118°39′35″ E., 310 fathoms, September 29, 1909.

U.S.N.M. no. 103056, 2 specimens, 39 and 40 mm, station 5592, latitude 4°12′44″ N., longitude 118°27′44″ E., 305 fathoms, September 29, 1909.

U.S.N.M. no. 103057, 1 specimen, 57 mm, station 5593, latitude 4°02′40″ N., longitude 118°11′20″ E., 38 fathoms, September 29, 1909.

U.S.N.M. no. 103058, 2 specimens, 57 and 63 mm, station 5621, latitude 0°15′00″ N., longitude 127°24′35″ E., 298 fathoms, November 28, 1909.

U.S.N.M. no. 103059, 1 specimen, 55 mm, station 5662, latitude 5°43′00″ S., longitude 119°18′00″ E., 211 fathoms, December 21, 1909.

U.S.N.M. no. 103037, 1 specimen, 50 mm, station 5267, latitude 13°42′20″ N., longitude 120° 58′25″ E., 170 fathoms, June 8, 1908.

POLYIPNUS FRASERI Fowler, 1934

Polyipnus fraseri FOWLER, Proc. Acad. Nat. Sci. Philadelphia, vol. 85, p. 257, fig. 19, 1934 (type, U. S. N. M. no. 92324, examined by the author).—PARR, Bull. Bingham Oceanogr. Coll., vol. 3, no. 7, p. 55, 1937.

The correct catalog number for the type in the United States National Museum is 92324 and not as published. The correct locality is *Albatross* station 5476, which is in latitude 12°56′24″ N., longitude 124°25′24″ E., and not as published. On Fowler's page 258, second paragraph, and fig. 19, p. 254, it is stated in the original description "no adipose fin." However, when the type was immersed in alcohol the small adipose fin showed up clearly. In fact all the species of this genus have a small adipose fin.

POLYIPNUS NUTTINGI Gilbert, 1905

Polyipnus nuttingi GILBERT, Bull. U. S. Fish Comm., vol. 23 (for 1903), pt. 2, p. 609, pl. 73, 1905 (type, U. S. N. M. no. 51599, examined by the author, *Albatross* station 4088, Pailolo Channel between Molokai and Maui, 297 to 306 fathoms).

Polyipnus spinosus (non Günther) GILBERT and CRAMER, Proc. U. S. Nat. Mus., vol. 19, p. 416, 1897 (U. S. N. M. no. 51593, cotypes, 33 specimens, 34 to 70 mm, *Albatross* station 4102, between Maui and Molokai Islands, Hawaii, 122 to 132 fathoms, July 23, 1902).

U. S. N. M. no. 47720, one specimen, 41 mm, *Albatross* station 3476, latitude 21°09′ N., longitude 157°53′ W., December 6, 1891.

Genus ARGYROPELECUS Cocco

Argyropelecus *Cocco, Arch. Accad. Peloritano, 1829, p. 146 (*A. hemigymnus* Cocco).

Pleurothyris *LOWE, A history of the fishes of Madeira, p. 64, 1843 (*Sternoptyx olfersii* Cuvier).

This genus may be recognized by the following characters: A distinct dorsal blade in front of the soft dorsal fin; no pair of spines just anterior to the origin of soft dorsal fin; 12 abdominal photophores; 6 supra-abdominal photophores; the lateral photophore is lacking, and 2 suprapectoral photophores; anal fin divided.

Argyropelecus elongatus Esmark (1871 p. 489) is too briefly described to be recognized. After examining the very inadequate descriptions and poor figure of *Argyropelecus bocagei* (Osorio, 1909, pp. 27–28, pl. 2, fig. 3; Seabra, 1911, p. 176; and Nobre, 1935, p. 350) I agree with Norman (1930) that it is unrecognizable.

SYNOPSIS OF THE SPECIES OF ARGYROPELECUS

a^1. No spine present at posterior end of abdomen below insertion of pelvic fins; photophores forming a nearly continuous series from behind pectoral to base of caudal fin; depth of body 1.8 to 2 and head 3.5 to 3.75 times in standard length (tip of snout to base of caudal fin rays); preopercle at

lower angle with one spine, which is nearly straight or a little curved outward and directed ventrally and above which is a very small one directed outward; greatest height of dorsal blade less than 1 time in base of soft dorsal and about 2.2 times in length of its own base. Range: Tropical Atlantic, off Africa----------gigas Norman, 1930

a^2. One or more spines (usually 1 or 2) located at posterior end of abdomen below insertion of pelvic fins.

b^1. Photophores forming a nearly continuous series from behind pectoral to base of caudal fin; posterior abdominal spines 2, of about equal length and directed downward; depth of body 2.2 to 2.6, head 3.2 to 3.5 times in standard length; preopercle at lower angle with 1 spine, straight or a little curved outward, directed downward, above which is a smaller one directed outward but not extending past rear margin of preopercle; height of dorsal blade 2.8 to 3.3 times in length of its base; no subcaudal spines; gill rakers 7 or 8 + 11 or 12. Range: Atlantic (West Indies; Caribbean; off Strait of Gibraltar; southern tip of Africa), Indian Ocean----------affinis Garman, 1899

b^2. Photophores not forming an almost continuous series but with spaces between the various groups as follows: Above insertion of pelvics, over first 1 to 3 or 4 anal rays, and anterior portion of caudal peduncle, sometimes including last few anal rays.

c^1. A single spine at posterior angle of abdomen.

d^1. Abdominal spine serrated and directed backward (often a minute spinule above its base posteriorly); depth of body 1.7 to 1.9, head 3.1 to 3.5 times in standard length; preopercle at lower angle with an almost straight spine directed downward, upper spine directed outward and backward, with tip extending past rear margin of bone; subcaudal spines absent; gill rakers more numerous than in any other species, about 9 to 11 + 11 to 14, totaling 20 to 25; dorsal soft rays usually 8. Range: Pacific (Hawaiian Islands; Philippine Islands; New Zealand?), Atlantic (West Indies; Bermuda; off South Carolina; Mediterranean; Central Atlantic; South Atlantic), Indian Ocean----------hemigymnus Cocco, 1829

d^2. Abdominal spine smooth and directed downward and usually curved a little forward; depth of body 1.2 to 1.4, head 3.1 to 3.5 times in standard length; preopercle at lower angle with one spine pointing straight downward and curved a little outward, the upper spine small, pointing outward, its tip not extending past rear margin of preopercular bone; subcaudal spines present in adults in front of subcaudal organs and below them; gill rakers 7 or 8 + 8 to 10, totaling 16 or 17; height of dorsal blade 1 to 1.5 times in length of its base; dorsal soft rays usually 9. Range: Atlantic (West Indies: Bahamas; off New Jersey, New York, and Cape Cod), South Pacific (Lord Howe Island)----------amabilis (Ogilby, 1888)

c^2. A pair of smooth spines at posterior angle of abdomen; gill rakers 7 to 9+8 to 10.

e^1. Postabdominal spine longer than anterior spine of pair of abdominal spines and directed backward, the two spines diverging at an angle of about 90° or a little more; adults with the dorsal and abdominal ridges serrated; adults with a double series of spines on lower edge of caudal peduncle; height of dorsal blade 1.3 to 1.5 in length of its base; lower preopercular spine directed straight downward and curved a little outward, upper spine small, its tip not extending past rear margin of preopercle. Range: Atlantic

(off Cape Cod, New Jersey, and Virginia; Grand Banks; North Sea; Gulf of Mexico; West Indies; off South African coast), Indian Ocean; Pacific (Philippine Islands).

aculeatus Cuvier and Valenciennes, 1850

e^2. Postabdominal spine about equal in length to anterior spine, the two spines diverging at an angle of about 45° to 50°; dorsal and abdominal ridges smooth; no spines on ventral margin of caudal peduncle.

f^1. Lower preopercular spine pointing downward, curved slightly forward and outward, the upper very small or absent, its tip not extending past rear margin of preopercle in adults; depth of body about 1.5 times in standard length; height of dorsal blade 1 to 1.4 times in length of its base. Range: Pacific (Baja California; off Panama), Atlantic (off New Jersey and off South Carolina), Indian Ocean----------olfersii (Cuvier, 1829)

f^2. Lower preopercular spine straight, directed downward and often a little curved outward but not forward, the upper of moderate size, directed outward and backward, its tip extending past rear margin of preopercular bone; depth of body 1.3 to 1.7 times in standard length; height of dorsal blade 1.7 to 2.3 times in length of its base. Range: Pacific (off Panama; Philippines; off southern Japan), North and South Atlantic, Antarctic, Indian Ocean----------sladeni Regan, 1908

ARGYROPELECUS GIGAS Norman, 1930

Argyropelecus gigas Norman, *Discovery* Reports, vol. 2, p. 302, fig. 10, 1930.—Jespersen, *in* Joubin, Faune ichthyologique de l'Atlantique nord, no. 15, 1934.—Fowler, Bull. Amer. Mus. Nat. Hist., vol. 70, p. 1208, 1936.—Parr, Bull Bingham Oceanogr. Coll., vol. 3, art. 7, p. 49, 1937.

ARGYROPELECUS AFFINIS Garman, 1899

Argyropelecus hemigymnus (non Cocco) Wood-Mason and Alcock, Ann. Mag. Nat. Hist., ser. 6, vol. 8, p. 126, 1891.

Argyropelecus hemigymnus (non Cocco) Goode and Bean, Oceanic ichthyology, pl. 39, fig. 147, 1895.

Argyropelecus affinis Garman, Mem. Mus. Comp. Zool., vol. 24, p. 237, 1899.—*Brauer, Sitz. Ges. Beförd. Naturw. Marburg, 1901, p. 120, fig. 1.—Brauer, Tiefsee-Expedition . . . *Valdivia*, vol. 15, p. 103, pl. 7, figs. 1, 2, 1906.—Regan, Trans. Linn. Soc. Zool., vol. 12, p. 218, 1908.—Murray and Hjort, The depths of the ocean, p. 612, pl. 2, 1912.—Jespersen, Report on the Danish Oceanographical Expeditions, 1908–1910, vol. 2, A. 2, p. 6, 1915.—Barnard, Ann. South African Mus., vol. 21, p. 152, pl. 8, fig. 1, 1925.—Townsend and Nichols, Bull. Amer. Mus. Nat. Hist., vol. 52, p. 11, 1925.—Norman, *Discovery* Reports, vol. 2, p. 301, fig. 9, 1930.—Roule and Angel, Résult. Campagnes Sci. Prince de Monaco, fasc. 86, p. 46, 1933.—Jespersen, *in* Joubin, Faune ichthyologique de l'Atlantic nord, no. 15, 1934.—Fowler, Bull. Amer. Mus. Nat. Hist., vol. 70, p. 246, fig. 115; p. 1208, 1936.—Parr, Bull. Bingham Oceanogr. Coll., vol. 3, art. 7, p. 49, 1937.

Specimens in the National Museum as follows:

U.S.N.M. no. 102776, length 39 mm, First Johnson-Smithsonian Deep-sea Expedition, 1933, tin tag no. 186, station 33, latitude 18°24'15" N., longitude 67°17'50" W., to latitude 18°26'40" N., longitude 67°14' W., February 9, 1933, 180 to 360 fathoms.

U.S.N.M. no. 102778, 25 mm, First Johnson-Smithsonian Expedition, 1933, tin tag no. 515, station 83, latitude 18°32'54" N., longitude 65°23'42" W., to latitude 18°32'15" N., longitude 65°18'45" W., 250 to 320 fathoms, February 26, 1933.

U.S.N.M. no. 44593, 32 mm, *Albatross* station 2117, latitude 15°24'40" N., longitude 63°31'30" W., 683 fathoms, January 27, 1884.

U.S.N.M. no. 87563, 42 mm, *Albatross* station 5686, SW. of Abreojos Point, 26°14' N., 114° W., 930 fathoms, April 22, 1911.

ARGYROPELECUS HEMIGYMNUS Cocco, 1829

Argyropelecus hemigymnus *Cocco, Arch. Accad. Peloritano, 1829, p. 146.—*Cocco, Giorn. Sci. Lett. Sicilia, vol. 26, fasc. 77, p. 146, 1829.—Cocco, Isis, vol. 24, p. 1342, 1831.—Bonaparte, Iconografia della fauna italica per le quattro classi degli animali vertebrati, vol. 3, fasc. 28, pl. 121, fig. 3, 1840.—Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 22, p. 398, 1849.—Günther, Catalogue of the fishes in the British Museum, vol. 5, p. 385, 1864.—Canestrini, Pesci d'Italia, *in* Cornalia's Fauna d'Italia, pt. 3, p. 119, 1870.—Doderlein, Atti Accad. Sci. Palermo, new ser., vol. 6, p. 54, 1879.—Leydig, Die augenähnlichen Organe der Fische, p. 26, pl. 1, fig. 5, 1881.—Moreau, Histoire naturelle des poissons de la France, vol. 3, p. 498, 1881.—Facciolà, Natural. Siciliano, vol. 2, p. 206, 1883.—Goode and Bean, Bull. Mus. Comp. Zool., vol. 10, p. 220, 1883.—Giglioli, 3d Congr. Geogr. Internaz., Venice, 1881, vol. 5, pp. 195, 199, 207, 1884.—Vinciguerra, Ann. Mus. Civ. Storia Nat. Genova, ser. 2a, vol. 2, p. 469, 1885.—Günther, Report . . . voyage of the H. M. S. *Challenger*, vol. 22, pt. 57, p. 167, 1887.—Jordan, Rep. U. S. Comm. Fish and Fisher., vol. 13 (for 1885), p. 833, 1887.—Vaillant, Expéditions scientifiques du *Travailleur* et du *Talisman*. . . , Poissons, p. 103, 1888.—Lütken, Spolia Atlantica, ser. 6, vol. 7, p. 283, 1892.—Carus, Prodromus faunae Mediterraneae, vol. 2, p. 568, 1893.—Goode and Bean, Oceanic ichthyology, p. 126 (in part; non fig. 147), 1895.—Alcock, Journ. Asiat. Soc. Bengal, vol. 65, p. 331, 1896.—Jordan and Evermann, U. S. Nat. Mus. Bull. 47, pt. 1, p. 604, 1896.—Alcock, A descriptive catalogue of the Indian deep-sea fishes in the Indian Museum, p. 135, 1899.—Handrick, Zoologica (Stuttgart), pt. 32, pp. 1–68, 6 pls., 1901.—Lo Bianco, Mitt. Zool. Stat. Neapel, vol. 16, nos. 7–9, pp. 126, 127, 129, 131, 132, 135, 138–141, 161, 1903.—Collett, Forh. Vid.-Selsk. Christiania, 1903, no. 9, p. 110, 1904.—*Bragança, Cat. Coll., p. 40, 1903.—Brauer, Tiefsee Expedition. . . *Valdiva*, vol. 15, p. 106, fig. 45, 1906.—Regan, Trans. Linn. Soc. Zool., vol. 12, p. 219, 1908.—Seabra, Bull. Soc. Portugaise Sci. Nat., vol. 5, fasc. 3, p. 176, 1911.—Zugmayer, Résult. Campagnes Sci. Prince de Monaco, fasc. 35, p. 51, 1911.—Murray and Hjort, The depths of the ocean, pp. 604, 612, 618, 643, 698, fig. 458, 1912.—Holt and Byrne, Fisher. Ireland Sci. Invest. 1912, no. 1, pp. 18–19, 21, figs. 7b, 8, 1913.—Pappenheim, Deutsche Südpolar Expedition, 1901–1903, vol. 15 (Zool. Abth. 7, p. 182, 1914).—Jespersen, Report on the Danish Oceanographic Expeditions, 1908–1910, vol. 2, A. 2, p. 7, 1915.—Roule, Résult. Campagnes Sci. Prince de Monaco, fasc. 52, p. 25, 1919.—Barnard, Ann. South African Mus., vol. 21, p. 153, 1925.—Jespersen and Tåning, Report on the Danish Oceanographic Expeditions, 1908–1910, vol. 2, A. 12, p. 48, 1926.—Norman, *Discovery* Reports, vol. 2, p. 303, pl. 2, fig. 4, 1930.—Borodin, Bull. Mus. Comp. Zool., vol. 72, p. 68, 1931.—Zugmayer, Résult. Campagnes Sci. Prince de Monaco, fasc. 86, p. 80, 1933.—Parr, Bull. Bingham Oceanogr. Coll., vol. 4, art. 6, p. 5, 1934.—*Noronha and Sarmento, Peixes Madeira, p. 117, 1934.—Jespersen, *in* Joubin, Faune ichthyologique

de l'Atlantique nord, no. 15, 1934.—NOBRE, Faune marinha de Portugal, vol. 1, p. 351, 1935.—FOWLER, Bull. Amer. Mus. Nat. Hist., vol. 70, p. 245, 1936.—PARR, Bull. Bingham Oceanogr. Coll., vol. 3, art. 7, pp. 49, 53, fig. 18 (3), 1937.—NORMAN, British, Australia, and New Zealand Antarctic Research Expedition, 1929–1931, Rept. Ser. B (Zool. Bot.), vol. 1, no. 2, p. 82, 1937.

Sternoptix mediterranea Cocco, Giorn. Il Faro, vol. 4, anno 6, p. 7, figs. 2a, 2b, opposite p. 16, 1838 (*Argyropelecus emigymnus* is the spelling used by Cocco, 1838, for a synonym of *S. mediterranea*).—BONAPARTE, Iconografia della fauna italica per le quattro classi degli animali vertebrati, vol. 3, fasc. 28, pl. 121, fig. 3, 1840.

?*Argyropelecus d'urvillei* CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 22, p. 405, 1850.—GÜNTHER, Catalogue of the fishes in the British Museum, vol. 5, p. 386, 1864.—GOODE and BEAN, Oceanic ichthyology, p. 127, 1895.

Argyropelecus intermedius CLARKE, Trans. Proc. New Zealand Inst., vol. 10 (for 1877), p. 244, pl. 6, 1878.

Argyropelecus heathi GILBERT, Bull. U. S. Fish. Comm., vol. 23 (for 1903), pt. 2, p. 601, pl. 72, fig. 1, 1905 (U.S.N.M. no. 51632, type, examined by author).—JORDAN and JORDAN, Mem. Carnegie Mus., vol. 10, no. 1, p. 9, 1922.—FOWLER, Fishes of Oceania, vol. 10, p. 35, 1928.

Argyropelecus "lychnus" (non Garman) LENDENFELD, Mem. Mus. Comp. Zool., vol. 30, p. 170, pl. 6, figs. 24, 25, 1905.

The following 35 specimens were collected by the First Johnson-Smithsonian Deep-sea Expedition, 1933, in the vicinity of the West Indies:

U.S.N.M. no. 102779, 5 specimens, length about 5 to 9 mm, tin tag no. 328, station 62, latitude 19°25′45″ N., longitude 69°09′00″ W., to latitude 19°27′45″ N., longitude 69°14′45″ W., depth about 350 fathoms, February 18, 1933.

U.S.N.M. no. 102780, 8 specimens, about 8 to 21 mm, tin tag no. 494, station 86, latitude 19°30′30″ N., longitude 65°14′00″ W., to latitude 19°18′30″ N., longitude 65°16′00″ W., about 350 fathoms, February 27, 1933.

U.S.N.M. no. 102781, 3 specimens, about 15 to 20 mm, tin tag no. 498A, station 87, latitude 19°18′30″ N., longitude 65°16′00″ W., to latitude 19°13′00″ N., longitude 65°16′00″ W., about 350 fathoms, February 27, 1933.

U.S.N.M. no. 102782, 8 specimens, about 7 to 14 mm, tin tag no. 176, station 30, latitude 18°40′30″ N., longitude 66°30′00″ W., to latitude 18°40′30″ N., longitude 66°36′15″ W., about 1,200 fathoms, February 8, 1933.

U.S.N.M. no. 102783, 1 specimen, length 19 mm, tin tag no. 461, station 85, latitude 18°39′30″ N., longitude 65°16′55″ W., to latitude 18°44′00″ N., longitude 65°16′15″ W., about 400 fathoms, February 26, 1933.

U.S.N.M. no. 102784, 2 specimens, 13 and 20 mm, tin tag no. 452, station 84, latitude 18°32′30″ N., longitude 65°18′30″ W., to latitude 18°39′00″ N., longitude 65°17′00″ W., about 300 to 350 fathoms, February 26, 1933.

U.S.N.M. no. 102785, 2 specimens, 21 and 27 mm, the larger fish has tag no. 510, the other 511, station 83, latitude 18°32′54″ N., longitude 65°23′42″ W., to latitude 18°32′15″ N., longitude 65°18′45″ W., about 250 to 320 fathoms, February 26, 1933.

U.S.N.M. no. 102786, 6 specimens, about 4 to 11 mm, tin tag no. 24C, station 5, latitude 18°37′00″ N., longitude 66°24′30″ W., about 600 fathoms, January 31, 1933.

The following specimens are also in the collections of the United States National Museum:

U.S.N.M. no. 100526, 1 specimen, 23 mm, *Grampus* station 10182, off Bermuda, latitude 30°27′ N., longitude 66°05′ W., 1,400 to 0 meters, February 19, 1914.

U.S.N.M. no. 100542, 1 specimen, 30 mm, *Grampus* station 10176, off Bermuda, latitude 32°30′ N., longitude 65°48′ W., 750 to 0 meters, February 5, 1914.

U.S.N.M. no. 100341, 1 specimen, 23 mm, *Grampus*, off South Carolina, latitude 32°33′ N., longitude 72°14′ W., 1,100 to 0 meters, January 30, 1914.

U.S.N.M. no. 103022, 1 specimen, 15 mm (bad condition), *Albatross* station 5184, latitude 10°18′30″ N., longitude 122°23′30″ E., 565 fathoms, March 30, 1908.

U.S.N.M. no. 103023, 1 specimen, 13 mm, *Albatross* station 5120, latitude 13°45′30″ N., longitude 120°30′15″ E., 393 fathoms, January 19, 1908.

Three lots of *Argyropelecus* here referred to *hemigymnus* possess more numerous gill rakers and may represent a distinct form of that species. They were taken in the Mediterranean and are listed as follows:

U.S.N.M. no. 40053, 18 specimens in bad condition, 20 to 28 mm, Messina, Italy, November, 1883.

U.S.N.M. no. 92244, 2 specimens, 33 and 35 mm, Ganzirri, Messina, Italy.

U.S.N.M. no. 10143, 2 specimens, one in bad condition, other, length 30 mm, Mediterranean Sea.

ARGYROPELECUS AMABILIS (Ogilby, 1888)

Sternoptychides amabilis OGILBY, Proc. Linn. Soc. New South Wales, ser. 2, vol. 3, p. 1313, 1888.

Argyropelecus olfersii (non Cuvier) GOODE and BEAN, Oceanic ichthyology, p. 126 (in part), pl. 39, fig. 148a, 1895.—ROULE and ANGEL, Résult. Campagnes Sci. Prince de Monaco, fasc. 86, p. 48, pl. 2, figs. 24, 24a, 1933.

Argyropelecus amabilis MCCULLOCH, Rec. Australian Mus., vol. 14, no. 2, p. 118, pl. 14, fig. 3, 1923.

Argyropelecus antrorsospinus SCHULTZ, Smithsonian Misc. Coll., vol. 91, no. 27, p. 1, fig. 1, 1937.

Argyropelecus micracanthus PARR, Bull. Bingham Oceanogr. Coll., vol. 3, art. 7, p. 52, fig. 21, 1937.

Parr (1937, p. 52, fig. 21) described as new *Argyropelecus micracanthus*, based on a specimen but 13 mm in standard length. During my examination of many more than a hundred specimens of various species of *Argyropelecus* from postlarvae up to large adults, it was observed that the anal, preanal, and subcaudal photophores do not all appear at once but develop gradually, the posterior one forming last. This gradual development of the anal photophores also occurs in the genus *Polyipnus*. Dr. Parr's figure 21 of *A. micracanthus* is obviously taken from a very young *Argyropelecus*, because the anal and subcaudal photophores are in little circular masses which at larger sizes extend a little anteriorly and considerably posteriorly. In con-

sideration of these facts and the lack of any other diagnostic characters, I consider it as a synonym of *A. amabilis*.

The following specimens were examined:

U.S.N.M. no. 102989 (holotype of *A. antrorsospinus*), off Culebra Island, latitude 18°32'54" N., longitude 65°23'42" W., to latitude 18°32'15" N., longitude 65°18'45" W., February 26, 1933, 250 to 320 fathoms.

U.S.N.M. no. 102987, *Albatross* station 2208, latitude 39°33'00" N., longitude 71°16'15" W., August 21, 1884.

U.S.N.M. no. 35561, *Albatross* station 2209, latitude 39°34'45" N., longitude 71°21'30" W., August 21, 1884.

U.S.N.M. no. 33393, *Albatross* station 2075, latitude 41°40'30" N., longitude 66°35'00" W., September 3, 1883.

U.S.N.M. no. 43855, *Albatross* station 2717, latitude 38°24' N., longitude 71°13' W., September 18, 1886.

ARGYROPELECUS ACULEATUS Cuvier and Valenciennes, 1849

Argyropelecus aculeatus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 22, p. 406, 1849.—Günther, Catalogue of the fishes in the British Museum, vol. 5, p. 386, 1864.—Sauvage, *in* Grandidier, Histoire physique, naturelle et politique de Madagascar, Poissons, vol. 16, p. 483, pl. 48, fig. 5, 1891.—Lütken, Spolia Atlantica, ser. 6, vol. 7, p. 282, 1892.—Goode and Bean, Oceanic ichthyology, p. 127, 1895.—Collett, Forh. Vid.-Selsk. Christiania, 1903, no. 9, p. 108, 1904.—Collett, Zool. Anz., vol. 28, p. 726, 1905.—Brauer, Tiefsee Expedition . . . *Valdivia*, vol. 15, p. 110, fig. 47, 1906.—Regan, Trans. Linn. Soc. London, vol. 12, p. 218, 1908.—Murray and Hjort, The depths of the ocean, pp. 612, 618, 643, 1912.—Jespersen, Report on the Danish Oceanographic Expeditions, 1908–1910, vol. 2, A. 2, p. 27, 1915.—Norman, *Discovery* Reports, vol. 2, p. 303, fig. 11, 1930.—Borodin, Bull. Mus. Comp. Zool., vol. 72, p. 68, 1931.—Zugmayer, Result. Campagnes Sci. Prince de Monaco, fasc. 86, p. 79, 1933.—Jespersen, *in* Joubin, Faune ichthyologique de l'Atlantique nord, no. 15, 1934.—Parr, Bull. Bingham Oceanogr. Coll., vol. 3, art. 7, pp. 47, 50, 53, fig. 18 (1a–1c), 1937.

Sternoptyx acanthurus Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 22, p. 408, 1849.

Argyropelecus olfersii (non Cuvier) Collett, Festskrift H. M. Kong Oscar II ved Regjerings-Jubilaeet 1897, vol. 2, p. 14, 1897.

?*Argyropelecus caninus* Garman, Mem. Mus. Comp. Zool., vol. 24, p. 235, 1899.

Argyropelecus olfersii (non Cuvier) Vladykov and McKenzie, Proc. Nova Scotia Inst. Sci., vol. 19, pt. 1, p. 60, fig. 40, 1935 (based on U. S. N. M. no 33495).

Argyropelecus acanthurus (non Cocco) Fowler, Bull. Amer. Mus. Nat. Hist., vol. 70, pp. 246; 1207, 1936. (Cocco described *Gasteropelecus acanthurus*, 1829, and in Isis, vol. 24, p. 1342, 1831, Cocco states that the species has "A. 30," which is for another species of fish. Therefore, the use of the name *acanthurus* of Cocco by Fowler for species of *Argyropelecus* has no basis, in my opinion.)

The following 9 specimens were examined:

U.S.N.M. no. 102777, 2 specimens, 8 and 13 mm, First Johnson-Smithsonian Deep-Sea Expedition, 1933, tin tag no. 24C, Station 5, latitude 18°37'00" N., longitude 66°24'30" W., about 600 fathoms, January 31, 1933.

U.S.N.M. no. 33495, 1 specimen, 18 mm, *Albatross* station 2063, latitude 42°23'00" N., longitude 66°23'00" W., August 31, 1883.

U.S.N.M. no. 35467, 1 specimen, 38 mm, *Albatross* station 2195, latitude 39°44'00" N., longitude 70°03'00" W., August 5, 1884.

U.S.N.M. no. 38116, specimen badly damaged, Grand Banks, September 3, 1886 (coll. W. A. Wilcox ?).

U.S.N.M. no. 74336, 1 specimen, 33 mm, *Albatross* station 2565, latitude 38°19'20" N., longitude 60°02' 30" W., August 28, 1885.

U.S.N.M. no. 86124, 2 specimens, 12 and 14 mm, *Grampus* station 10445, Gulf of Mexico, January 25, 1917.

U.S.N.M. no. 103024, 1 specimen, 16 mm, *Albatross* station 5246, latitude 6°29'15" N., longitude 126°18'45" E., depth not given, May 15, 1908.

ARGYROPELECUS OLFERSII (Cuvier, 1829)

Sternoptyx olfersii Cuvier, Le règne animal, ed. 2, vol. 2, p. 316, 1829.—Düben and Koren, Kungl. Vet.-Akad. Handl., 1844, p. 80, pl. 3, fig. 6, 1844.

Argyropelecus olfersii Cuvier and Valenciennes, Histoire naturelle des poissons, vol. 22, p. 408, 1849.—Lowe, Proc. Zool. Soc. London, 1850, pt. 18, p. 247.—Günther, Catalogue of the fishes in the British Museum, vol. 5, p. 386, 1864.—Günther, Rep. Voyage H. M. S. *Challenger* 1873–1876, Zool., vol. 22, p. 167, 1887.—Collett, Forh. Vid.-Selsk. Christiania, 1879, no. 1, p. 84.—Collett, Nyt. Mag. Naturv., vol. 29, p. 102, 1885.—Jordan, Rep. U. S. Comm. Fish and Fisher., vol. 13 (for 1885), p. 833, 1887.—Vaillant, Expéditions scientifiques du *Travailleur* et du *Talisman* . . ., Poissons, p. 104, 1888.—Lilljeborg, Sveriges och Norges fiskarne fauna, vol. 3, p. 3, 1891.—Lütken, Spolia Atlantica, ser. 6, vol. 7, p. 282, 1892.—Lütken, Vid. Medd. naturhist. For. Kjøbenhavn, 1891, p. 211, 1892.—Vinciguerra, Atti Soc. Ital. Sci. Nat., vol. 34, p. 331, 1893.—Smitt, A history of Scandinavian fishes, ed. 2, vol. 2, p. 925, fig. 233, 1895.—Goode and Bean, Oceanic ichthyology, p. 126 (non fig. 148 or 148a), 1895.—Jordan and Evermann, U. S. Nat. Mus. Bull. 47, pt. 1, p. 604, 1896.—Collett, Résult. Campagnes Sci. Prince de Monaco, fasc. 10, p. 127, pl. 3, fig. 14, 1896.—Collett, Forh. Vid.-Selsk, Christiania, 1903, no. 9, p. 105, 1904.—Brauer, Tiefsee Expedition . . . *Valdivia*, vol. 15, p. 108, fig. 46, 1906.—Regan, Trans. Linn. Soc. London, vol. 12, p. 219, 1908.—Seabra, Bull. Soc. Portugaise Sci. Nat., vol. 5, fasc. 3, p. 176, 1911.—Zugmayer, Résult. Campagnes Sci. Prince de Monaco, fasc. 35, p. 52, 1911.—Murray and Hjort, The depths of the ocean, pp. 612, 643, 1912.—Holt and Byrne, Fisher. Ireland Sci. Invest. 1912, no. 1, pp. 18–20, fig. 7a, 1913.—Weber and Beaufort, The fishes of the Indo-Australian Archipelago, vol. 2, p. 134, fig. 49, 1913.—Weber, Die Fische der *Siboga* Expedition, p. 21, 1913.—Jespersen, Report on the Danish Oceanographic Expeditions, 1908–1910, vol. 2, A. 2, p. 23, 1915.—Roule, Résult. Campagnes Sci. Prince de Monaco, fasc. 52, p. 25, 1919.—Barnard, Ann. South African Mus., vol. 21, p. 153, 1925.—Kyle and Ehrenbaum, Die Fische der Nord un Ostsee, p. xii, f. 54, fig. 32, 1929.—Norman, *Discovery* Reports, vol. 2, p. 304, fig. 12, 1930.—Zugmayer, Résult. Campagnes Sci. Prince de Monaco, fasc. 86, p. 80, 1933.—Jespersen, *in* Joubin, Faune ichthyologique de l'Atlantique nord, no. 15, 1934.—Fowler, Bull. Amer. Mus. Nat. Hist., vol. 70, p. 243, fig. 114, and p. 1207, 1936.—Parr, Bull. Bingham Oceanogr. Coll., vol. 3, art. 7, pp. 46, 50, fig. 18 (5), 1937.

Pleurothyris olfersi Lowe, A history of the fishes of Madeira, pt. 1, p. 64, 1843.

Argyropelecus lynchus GARMAN, Mem. Mus. Comp. Zool., vol. 24, p. 234, pl. J, figs. 1, 1b, 1899.—BELANSKE, *in* Vanderbilt, To Galápagos on the *Ara* 1926, Appendix C, p. 132, pl. 5, 1927.

Argyropelecus lichnus TOWNSEND and NICHOLS, Bull. Amer. Mus. Nat. Hist., vol. 52, p. 11, 1925.

The following specimens examined:

U.S.N.M. no. 35534, 1 specimen, 39 mm, *Albatross* station 2208, latitude 39°33'00" N., longitude 71°16'15" W., August 21, 1884.

U.S.N.M. no. 38211, 1 specimen, 53 mm, *Albatross* station 2728, latitude 36°30'00" N., longitude 74°33'00" W., October 25, 1886.

The recent work by Parr (1937) indicates that *olfersii*, *lynchus*, and *sladeni* each may be distinct species. I have examined many specimens of this general form and have concluded that because of much variation in bodily proportions most of the differences indicated by Dr. Parr do not hold good. Therefore since *lynchus* appears to have a higher dorsal blade and the upper preopercular spine is shorter, it is tentatively placed in the synonymy of *olfersii*.

ARGYROPELECUS SLADENI Regan, 1908

Argyropelecus sladeni REGAN, Trans. Linn. Soc. Zool., vol. 12, p. 218, 1908.—NORMAN, *Discovery* Reports, vol. 2, p. 304, fig. 13, 1930.—JESPERSEN, *in* Joubin, Faune ichthyologique de l'Atlantique nord, no. 15, 1934.—FOWLER, Bull. Amer. Mus. Nat. Hist. vol. 70, p. 1207, 1936.—PARR, Bull. Bingham. Oceanogr. Coll., vol. 3, art. 7, pp. 46, 47, 50, figs. 18 (4), 19, 1937.

The following 50 specimens examined, all from *Albatross* stations:

U.S.N.M. no. 57885, 2 specimens, 26 and 46 mm, station 3360, latitude 6°17' N., longitude 82°05' W., 1672 fathoms, February 24, 1891, or station 3395, latitude 7°30'36" N., longitude 78°39' W., 730 fathoms, March 11, 1891.

U.S.N.M. no. 102787, 1 specimen, 39 mm, station 4913, northwest Pacific, latitude 31°39'10" N., longitude 129°22'30" E., 391 fathoms, August 12, 1906.

U.S.N.M. no. 103013, 2 specimens, one 11 mm, other larva, station 5120, latitude 13°45'30" N., longitude 120°30'15" E., depth 393 fathoms, January 21, 1908.

U.S.N.M. no. 103014, 1 specimen in poor condition, station 5185, latitude 10°5'45" N., longitude 122°18'30" E., 638 fathoms, March 30, 1908.

U.S.N.M. no. 103015, 2 specimens, 27 and 34 mm, station 5368, latitude 13°35'30" N., longitude 121°48' E., 181 fathoms, February 23, 1909.

U.S.N.M. no. 103016, 1 specimen, 27 mm, station 5387, latitude 12°54'40" N., longitude 123°20'30" E., 209 fathoms, March 11, 1909.

U.S.N.M. no. 103017, 1 specimen in bad condition, station 5447, latitude 13°28' N., longitude 123°46'18" E., 310 fathoms, June 4, 1909.

U.S.N.M. no. 103018, 4 specimens, 14 to 19 mm, station 5497, latitude 9°7'15" N., longitude 124°59'30" E., 960 fathoms, August 3, 1909.

U.S.N.M. no. 103019, 34 specimens, 7 to 19 mm, station 5500, latitude 8°37'45" N., longitude 124°36'45" E., 267 fathoms, August 4, 1909.

U.S.N.M. no. 103020, 1 specimen, 35 mm, station 5525, latitude 9°12'30" N., longitude 123°44'7" E., 805 fathoms, August 11, 1909.

U.S.N.M. no. 103021, 1 specimen in poor condition, station 5530, latitude 9°26'45" N., longitude 123°38'30" E., depth not given, August 11, 1909.

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REVISION OF THE BEETLES OF THE MELOLONTHINE SUBGENUS PHYTALUS OF THE UNITED STATES

By LAWRENCE W. SAYLOR

SEVERAL years ago I began the study of the scarabaeid beetles of the subgenus *Phytalus* Erichson (genus *Phyllophaga* Harris) with the aim of bringing together in one paper data on all the described species, since the literature on the group is somewhat scattered and unavailable to many. It develops that several changes in taxonomic standing are necessary, and the knowledge of the distribution of the various species is greater than has been recorded. In this subgenus the genitalia of both sexes are of great use as supplementary diagnostic characters, and except in the case of *Phyllophaga* (*Phytalus*) *omani* Sanderson they have not been previously figured.

I am indebted to Dr. E. A. Chapin, Dr. M. A. Sanderson, Prof. E. C. Van Dyke, and Mark Robinson for the loan of material and for many other kindnesses.

The group as now defined is restricted to the American continents and adjacent islands and includes more than 60 described species, more than half of which inhabit Central America and the West Indies. In the United States the insects are found most commonly in the southern regions, specimens having been seen from Arizona, New Mexico, Texas, Georgia, Alabama, and Tennessee and also from New Jersey. I have recently received specimens of two of our United States species, *P. pallida* Horn and *P. sonora* Saylor (=*debilis* LeConte), from northern Mexico; a check of the literature reveals that these two species are apparently not recorded under any other name in Mexican faunal works.

Phytalus vexatus Horn (=*cavifrons* Linell) has been removed by Chapin to the genus *Chlaenobia*, which differs from *Phyllophaga* (and *Phytalus*) in that the tarsal soles are usually very densely pilose in the male and the hind thoracic angles usually constricted rather abruptly at the base; the genus *Chlaenobia* also has a distinct facies, enabling one familiar with the group to recognize specimens on sight. Some of the true *Listrochelus* (e. g., *scoparius*) also have densely pilose soles in the male sex, and later studies may show that *Chlaenobia* may be better placed as a subgenus.

Phytalus is no longer tenable as a genus because some of the species exhibit characters that absolutely grade into those of *Phyllophaga* and leave no single character or group of characters distinguishing the two. Although it can no longer be used in a generic sense, the name *Phytalus* is of use subgenerically as applied to a group of species having narrowly cleft claws in at least the male sex.

In probably no other group of American scarab beetles is there such a variety of opinion as to the validity of genera and of their names as in that of the phyllophagans. In 1920 Arrow, of the British Museum, stated that *Phytalus*, *Brahmina*, and *Holotrichia* were not separable from *Phyllophaga* (=*Lachnosterna*), and with this I heartily agree,[1] as I have found by experience that the use of the claws alone for generic characters is in most instances unsatisfactory because the claws may be very different in species that in every other character are obviously of the same genus.

In *Phyllophaga*, as at present recognized, there are several good groups, which, if segregated as different genera, however, would separate species greatly alike in most characters and apparently of the same lineage. Such a separation would, in most instances, be on the basis of the male characters alone, certainly undesirable criteria for generic definitions. Among such characters are the deformed middle claws, fixed hind tibial spurs, and narrowly cleft tarsal claws; the first two are nonvariable, but the last varies greatly in degree in the sexes. Another group could be defined if the very long basal claw dilation, giving the appearance of a third tooth, were used; in the single species concerned, *P. heteronyoha* Bates, the tarsal claws of the fore and midlegs are 3-toothed, while those of the hind pair, like those of *Phytalus*, are narrowly cleft. Such a segregation is unadvisable, however, as all degrees in length of the tooth formed by the basal dilation can be found in various species. Furthermore, in my opinion it would serve no useful purpose to form a special genus for those species in which the usual three segments of the antennal club are increased to four or five, as other characters are the same as in the species with the normal number of segments in the club.

[1] See Revista Ent., vol. 7, fasc. 2–3, pp. 318–322, 1937.

In the course of the present studies, I examined nearly every one of the United States species and also well over a 100 species of Neotropical *Phyllophaga* and allied genera, and in addition more than 50 species of Oriental *Brahmina*, *Holotrichia*, and allied groups. The necessity is apparent of suppressing the name *Brahmina* entirely and of ranking the American *Phytalus* and the Oriental *Holotrichia* as subgenera of *Phyllophaga*. This action has been suggested at one time or another, in whole or in part, by nearly every serious student of the group from Blanchard's time on (Blanchard, Bates, Arrow, Chapin, and Saylor), and the change was finally made by me in a recent paper (see footnote 1).

The position of other related genera, *Listrochelus* and *Chirodines*, is also open to some question; the former name seems to be valid for subgeneric use if restricted to a certain group of species, as has been done in a revision now in preparation by Dr. E. A. Chapin and myself. The genus *Chirodines* was separated on the basis of only a slight difference in the claws, and when thoroughly studied may quite possibly be shown to merit only subgeneric status, or may entirely fail of recognition.

Little is known regarding the economic status of the majority of the species, but *P. pallida* Horn has been observed doing a good deal of damage in Arizona by eating the foliage of rose bushes, young fruit trees, and walnut trees, often stripping them.

If the subgenus *Phytalus* is restricted to those species of *Phyllophaga* having the very narrowly cleft tarsal claws, it embraces the following species in our fauna: *P. bilobatata* Saylor, *P. georgiana* Horn, *P. omani* Sanderson, *P. pallida* Horn, *P. sandersonia* Saylor, *P. sonora* Saylor, and *P. obsoleta vanalleri* Schaeffer. The males usually have a flat or convex abdomen, as viewed from the side, and the antennal club is as long or nearly as long as the funicle; the females usually have the abdomen concave and robust and the antennal club much shorter than the funicle.

KEY TO THE SPECIES OF THE SUBGENUS PHYTALUS

MALES

1. Hind tibiae with 1 spur free, the other fixed and immovable 2
 Both hind tibial spurs free, movable 4
2. Upper tooth of claw longer to very much longer than lower one; antennae 9-segmented 3
 Upper tooth much shorter and narrower than lower tooth; antennae 10-segmented sandersonia
3. Yellow-testaceous; scutellum distinctly punctured only at sides; lower tooth of claw two-thirds or more as long as upper; fixed spur of hind tibia directly contiguous with tibial margin omani
 Rufotestaceous; scutellum evenly punctured over entire surface; lower claw tooth shorter; not more than one-half as long as upper; entire apical margin or posterior tibia distinct georgiana
4. Fifth abdominal segment flattened at middle and coarsely punctate, not granulate; color reddish brown to piceous bilobatata
 Fifth abdominal segment lobate or with granular tumosities 5
5. Upper tooth of claw much shorter than lower, claw very wide at base; fifth abdominal segment with a large triangularly shaped lobe, the latter incised at apex and projecting back over sixth segment obsoleta vanalleri
 Upper tooth of claw much longer than lower, fifth abdominal segment without a triangular lobe 6
6. Lobe of fifth abdominal segment reaching to or beyond apical margin, granulate, faintly bilobed at apex; pygidium coarsely rugose-punctate pallida
 Lobe of fifth abdominal segment less evident, the surface more tumid, with transverse granules; pygidium smooth, sparsely punctured sonora

FEMALES

1. Pygidium with a distinct tubercle just above apex 2
 Pygidium without tubercle, plane or sometimes thickened apically 3
2. Densely clothed above with short, erect, tawny hairs; thorax regularly and densely punctured, the punctures practically touching one another sandersonia
 Pronotum and elytra nearly or quite glabrous; thorax sparsely punctured, the punctures separated by 2 to 4 times their diameters obsoleta vanalleri
3. Lateral thoracic margins distinctly crenulate; claws narrowly cleft, upper tooth longer than lower; front very closely, coarsely rugose-punctate pallida
 Lateral thoracic margins entire or nearly so 4
4. Clypeus narrowly and deeply emarginate; color dark castaneous to rufopiceous bilobatata
 Clypeus broadly but not deeply emarginate; color testaceous or rufotestaceous 5
5. Last abdominal segment almost flat, slightly transversely sulcate; pygidium densely or sparsely punctured (Eastern United States) 6

Last abdominal segment convex, not sulcate; pygidium sparsely punctured (Arizona, Mexico) sonora

6. Scutellum densely, closely punctured; pygidium evenly punctured georgiana

Scutellum punctured only at sides; pygidium irregularly punctured omani

PHYLLOPHAGA (PHYTALUS) SANDERSONIA, new name

PLATE 9, FIGURES 1*a*–1*c*

Phytalus robustus HORN, Trans. Amer. Ent. Soc., vol. 12, p. 120, 1895 (*nec* LeConte, 1856).

Phytalus trichodes BATES, Biologia Centrali-Americana, vol. 2, pt. 2, p. 178. 1890.

Male.—Robust, elongate-oval, rufocastaneous, shining, entirely clothed above with short, very dense, suberect hair, that of front longer. Head with front exceedingly densely variolate-punctate, the punctures of moderate size and closely contiguous; clypeus punctured like front but less densely so, its apex moderately reflexed and slightly emarginate at middle. Antennae 10-segmented, club subequal to or very slightly longer than funicle. Thorax very regularly and extremely densely, evenly punctured over the entire surface; hind angles obtusely angulate; lateral margins almost evenly arcuate, crenulate, ciliate. Elytra very rugosely wrinkled, densely punctured, striae other than sutural weakly indicated. Pygidium with or without a very short longitudinal carina at center of basal margin, surface flattened near apex, evenly and densely punctured over the entire surface, with dense moderately long suberect hairs; apex subtruncate to subrounded. Abdomen polished, sparsely hairy, widely, shallowly and longitudinally concave at center; fifth segment plane, with moderately dense setigerous punctures at sides and apex; sixth two-thirds as long as fifth, more coarsely punctured and with longer erect hairs. Fixed spur of hind tibia short and twisted. All claws with upper tooth much shorter and more slender than lower. Front tarsi with segments 1 to 3, inclusive, with the inner apical margin prolonged into a strong spine, this character most strongly marked in segment 1.

Female.—Pygidium glabrous, sparsely punctured, declivate, and with a tubercle before apex; posterior tibial spurs free, elongate. (Amended from original description.)

Length, 17–20 mm. Width, 8.5–10 mm.

Remarks.—Horn described the species from the Rio Grande country near Matamoros, and I have seen two specimens (that were compared with the type) from Brownsville, Tex. (F. H. Snow and Charles Schaeffer), and also one male from Del Rio, Tex. (May 15, 1937, A. Meade). Described by Bates from Las Vigas, Veracruz

Mexico, and seen by me from Jalapa and Monterrey in Mexico (June). A comparison of the external features and of the genitalia of a cotype of Bates' species with Horn's species proves the two are identical. This species, to date, has been very rare in the United States, and less than a dozen specimens in American collections are known to me as having been taken within our boundaries; it was cited by Bates as being rather numerous at Las Vigas, Veracruz. The species is named for my good friend Dr. M. W. Sanderson.

PHYLLOPHAGA (PHYTALUS) OMANI Sanderson

PLATE 9, FIGURES 2*a*–2*e*

Phyllophaga (*Phytalus*) *omani* SANDERSON, Journ. Kansas Ent. Soc., vol. 10, p. 66, 1937.

Male.—Elongate, cylindrical, yellow-testaceous, the head piceous, surface shining. Head with front moderately and not closely punctured, the punctures separated by one to several times their own diameters; clypeus deeply marginate and moderately punctured; clypeal suture lightly impressed. Antennae 9-segmented, the club as long as the entire stem, unicolorous. Prothorax moderately, rather unevenly punctured, the punctures closer along the anterior and basal margins; sides parallel in basal half, then gradually rounded to apex; with an indistinct fuscous spot near the rounded lateral margins. Elytra punctured like thorax, somewhat rugose, costae except sutural obsolete. Pygidium rather strongly convex, finely and evenly punctured with a few short hairs at apex, remaining surface glabrous. Abdomen somewhat flattened at middle and with vague longitudinal impressions on segments 3 and 4; segment 5 plane; segment 6 slightly excavated at middle and with a small punctate elevation each side of middle. One of the spurs of the hind tibia short and fixed. Upper portion of the claw nearly as wide as lower and distinctly longer. Lower claw margin very finely and minutely, irregularly crenulate.

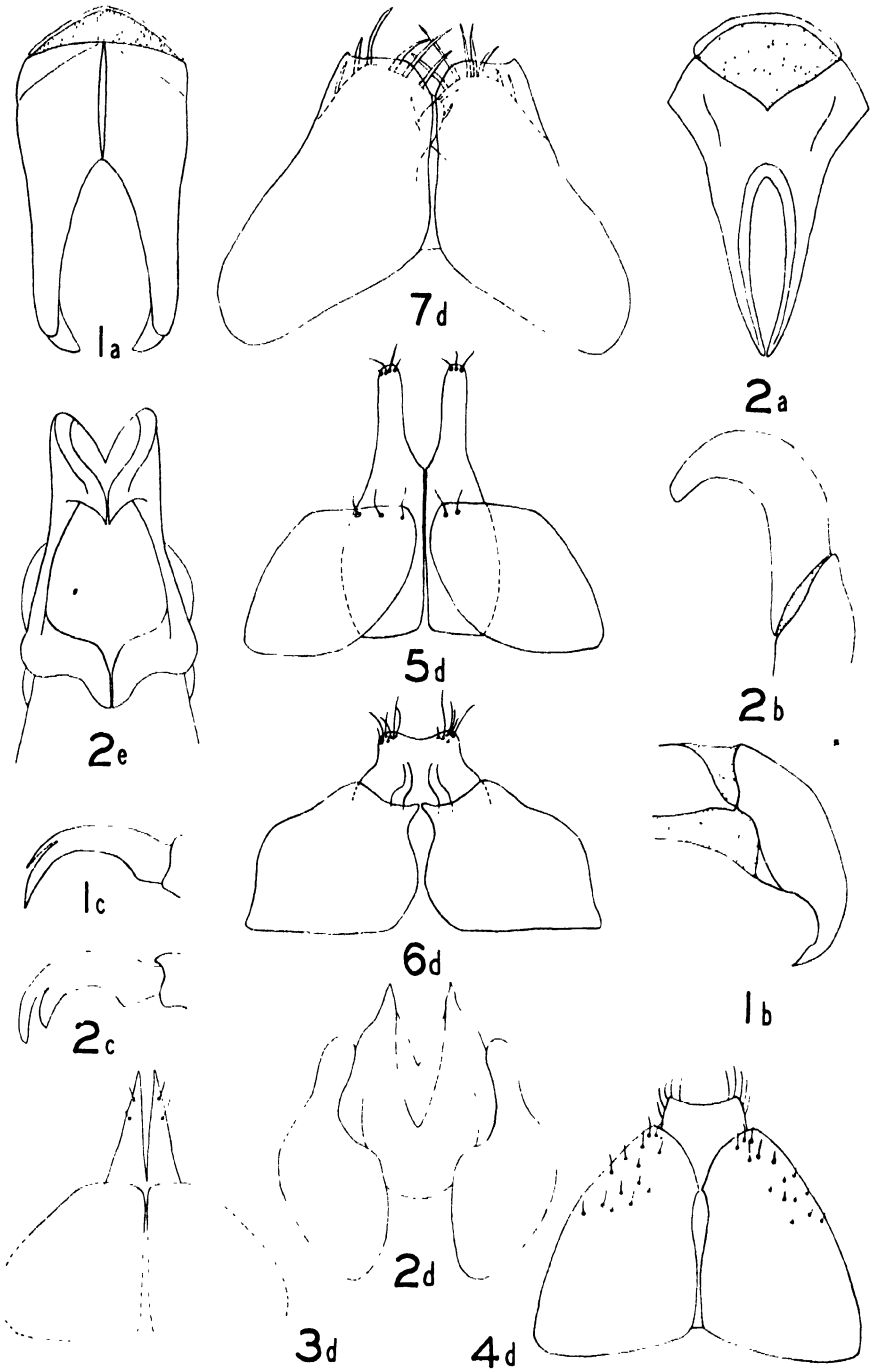
Female.—Club of antennae shorter than funicle; hind tibial spurs free; abdomen somewhat flattened at middle; pygidium transverse and evenly punctured. Otherwise similar to male.

Length, 14 mm. Width, 6 mm.

EXPLANATION OF PLATES 9 AND 10

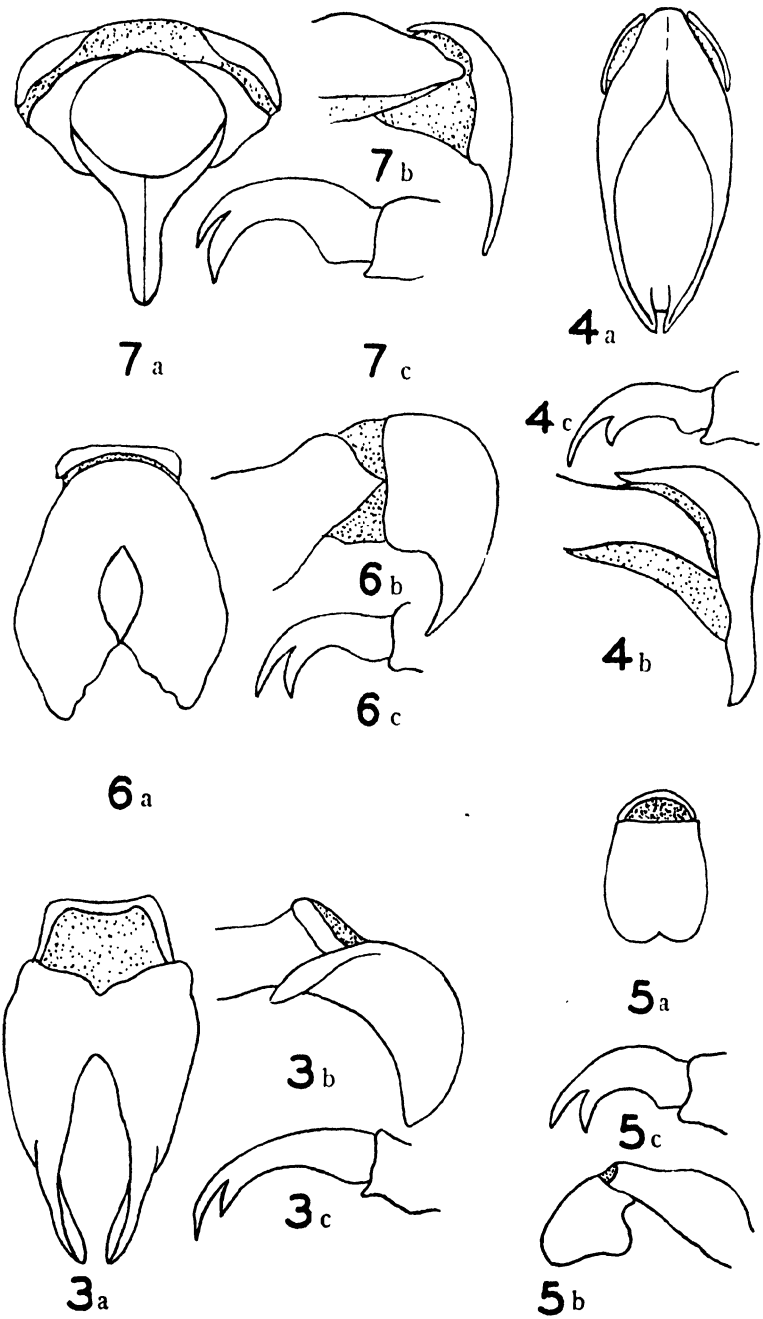
1, *Phyllophaga* (*Phytalus*) *sandersonia*, new name; 2, *P.* (*P.*) *omani* Sanderson; 3, *P.* (*P.*) *georgiana* (Horn); 4, *P.* (*P.*) *bilobatata*, new name; 5, *P.* (*P.*) *pallida* (Horn); 6, *P.* (*P.*) *sonora*, new name; 7, *P.* (*P.*) *obsoleta vanalleri* (Schaeffer).

Letters indicate views, as follows: *a*, En face view of male genitalia; *b*, side view of male genitalia; *c*, tarsal claw; *d*, female genitalia; *e*, en face-ventral view of male genitalia.



GENITALIA AND TARSAL CLAW OF PHYTALUS.

(FOR EXPLANATION OF PLATE SEE PAGE 162.)



GENITALIA AND TARSAL CLAW OF PHYTALUS.

(FOR EXPLANATION OF PLATE SEE PAGE 162.)

Remarks.—This interesting species is known only from the type material; the above description is condensed from the original. The holotype and allotype are from Burnsville, Ala. (July 20, 1930), and Prattsburg, Ga. (July 24, 1930), respectively; through the courtesy of Dr. Sanderson I was allowed to examine the male type before its description. One male in my collection from "North America."

PHYLLOPHAGA (PHYTALUS) GEORGIANA (Horn)

PLATE 9, FIGURE 3*d*; PLATE 10, FIGURES 3*a*–3*c*

Phytalus georgianus HORN, Trans. Amer. Ent. Soc., vol. 12, p. 122, 1885.

Male.—Rufous to rufotestaceous, head and thorax darker, surface shining with a few short scattered hairs. Front of head coarsely punctured, slightly rugose, with a small very irregular impunctate area near the vertex; clypeal suture deeply impressed at sides only; clypeus coarsely rugose-punctate; apex acutely not deeply but rather broadly emarginate; antennal club slightly longer than remainder of the antennae, third and fourth segments elongate. Sides of thorax not crenulate, hind angles rectangular, front angles very obtuse, disk coarsely and densely variolate-punctate, a few minute hairs near middle of the base. Elytra densely and coarsely rugose-punctate. Pygidium very convex, rather densely and irregularly punctured, glabrous, apex broadly rounded. Abdomen flattened at middle, polished, with a few setigerous punctures; segment 5 much shorter than 6, abruptly and narrowly declivate at apical margin; segment 6 slightly concave at center, with a transverse carina, the latter bearing a row of sparse hairs, and the row interrupted at middle. Hind tibial spurs spiniform, with the fixed one half as long as the other.

Female.—In the specimen at hand, the antennae are 8-segmented, with segment 3 very elongate, but it is probable that the normal number of segments is 9; club equal to segments 3–5 combined; last abdominal segment very shallowly transversely sulcate, sparsely punctured and fimbriate at apex; tibial spurs elongate, free; otherwise similar to male.

Length, 12.5–13 mm. Width, 6–6.5 mm.

Remarks.—I have seen collected specimens from Whitesbog, N. J. (July 9), "Barcoure," Ala., and three bred specimens from Lakehurst, N. J.

Described from Georgia, this rather rare species is distinctly separated from the others by the sexual characters. Horn, in describing the species, apparently overlooked the fact that one hind tibial spur in the male is definitely fixed and immovable, though unless careful examination is made the spurs appear to be free.

PHYLLOPHAGA (PHYTALUS) OBSOLETA VANALLERI (Schaeffer)

PLATE 9, FIGURE 7*d*; PLATE 10, FIGURE 7*a–7c*

Phytalus obsoletus BLANCHARD, Catalogue de la collection entomologique, vol. 1, p. 131, 1850.

Phytalus vanalleri SCHAEFFER, Bull. Brooklyn Ent. Soc., vol. 22, p. 215, 1927.

Male.—Elongate, subparallel, head and thorax rufous, otherwise testaceous to rufotestaceous, thorax and elytra glabrous, shining. Front of head closely, more or less confluently punctured, with long, erect, testaceous hair; a narrow area behind clypeal suture smooth and impunctate; clypeal suture not impressed; clypeus broad, faintly emarginate at middle of the subtruncate apex, the latter strongly reflexed, disk coarsely and sparsely punctured; antennal club usually longer than the rest of the antennae. Thoracic angles obtuse but well defined, base margined except at the middle, sides subangulate, subcrenulate; disk moderately, densely, and regularly umbilicate-punctate, with a small, irregular, median impunctate area; a few of the punctures with a minute testaceous hair. Elytra densely rugose-punctate, with a few hairs near apex. Pygidium very convex, polished, sparsely punctured, with suberect hairs; disk narrowly impressed before apex, the latter broadly rounded and ciliate. Abdomen shallowly impressed at middle, the concavity densely and finely setigerously punctate, the hair long and fine; segment 5 with a broad transverse carina near apical margin widely interrupted at middle, the carina densely pilose; segment 5 including the lobe as long as segments 3 and 4 combined; sides of abdomen sparsely punctured. Posterior spurs long, free.

Female.—Median impunctate area of thorax broader, with the punctures more distinct, middle of abdomen very slightly canaliculate, regularly and sparsely punctured, almost glabrous and highly polished; segment 5 more densely punctured at the slightly raised apical margin; segment 6 slightly convex, coarsely and sparsely punctured; antennal club equal to segments 3–7 combined; otherwise similar to male.

Length, 16–17 mm. Width, 7.5–8 mm.

Remarks.—This form is rather uncommon in the Southeast, but specimens have been seen from Alabama, Texas, and Louisiana. It is easily separated from all others of our fauna by the sexual characters, and in these it is similar to *P. obsoleta* Blanchard, which is a common species in Mexico, Guatemala, and Nicaragua; the two are very close, and *P. vanalleri* Schaeffer is probably best regarded at present as a northern subspecies having a longer antennal club (often two-fifths longer than the funicle), more crenate lateral thoracic margins, less elevated pectinate teeth on the lobe of the fifth abdominal

segment, very sparsely punctured clypeus, and smoother front; individuals are not lacking, however, in which almost all intermediate degrees of these characters appear, and possibly when more specimens have been seen from northern Mexico and southeastern United States the name *P. vanalleri* Schaeffer may have to be withdrawn altogether.

The antennal club of *P. vanalleri* Schaeffer is very variable; in most specimens it is as long as or longer than the stem and scape combined, while in almost all specimens of typical *P. obsoleta* Blanchard the club is noticeably shorter than the scape and funicle combined (averages about one-fifth longer than the funicle) as well as being lighter in color. The clypeus of typical *P. obsoleta* Blanchard is almost always densely punctured, while that of *P. vanalleri* Schaeffer is sparsely punctured at the middle of the clypeal suture.

PHYLLOPHAGA (PHYTALUS) BILOBATATA, new name

PLATE 9, FIGURE 4*d*; PLATE 10, FIGURES 4*a*–4*c*

Phytalus cephalicus HORN, Trans. Amer. Ent. Soc., vol. 12, p. 120, 1885 (not *cephalica* LeConte, 1856).

Male.—Elongate, dark castaneous to piceous, shining, usually glabrous above. Head with front densely variolate-punctate; clypeal suture rather deeply impressed, slightly bisinuate; clypeus broad, deeply and very narrowly emarginate at apex, giving a bilobed appearance to the apical margin, surface slightly tumid in some examples, densely, coarsely, and somewhat confluently punctured; antennal club slightly smaller than the stem, antennae 10-segmented. Thorax with a faint suggestion of a longitudinal sulcus on the disk in some examples, sides obtusely rounded, hind angles obtuse but distinct, margin entire, disk finely, sparsely and rather regularly punctured, a more or less irregular smooth space at middle. Elytra moderately densely and rugosely punctured, sometimes with very minute testaceous hairs. Pygidium very convex, densely and rugosely punctured, the punctures each with a short hair; apex broadly rounded, with a few longer hairs. Abdomen convex, very sparsely and finely punctured at middle, segment 5 depressed behind, a small group of sparse, long, erect hairs on each side of the segment; segment 6 elevated, densely punctate, abruptly declivous at base, in some cases with a faint trace of a longitudinal impression. Posterior spurs long, narrow, and free.

Female.—Antennal club much smaller; abdomen more convex, last segment longer and less densely punctured; otherwise similar to male.

Length, 15–18 mm. Width, 6–7.5 mm.

Remarks.—All positively identified material is from Arizona; localities represented are Nogales, Carr Canyon, Fort Grant, and "Chiri-

cahua Mts.," all collected in June or July. The pygidium and clypeus vary from slightly convex to tumid; in one female example the basal half of the pygidium is semitumid. Schaeffer points out that the last paragraph in Horn's description of *P. robusta* (Horn) (i. e., *sandersonia* Saylor) in reality refers to this species, which would seem to indicate that this species occurs in New Mexico; I have not seen specimens, however, from that State.

PHYLLOPHAGA (PHYTALUS) PALLIDA (Horn)

PLATE 9; FIGURE 5*d*; PLATE 10, FIGURES 5*a*–5*c*

Phytalus pallidus HORN, Trans. Amer. Ent. Soc., vol. 12, p. 121, 1885; 6th Ann. Rept. Arizona Comm. Hort. and Ent., p. 30, 1914.

Male.—Testaceous, head and thorax rufotestaceous, almost glabrous, surface moderately shining. Head with front densely and coarsely punctured; clypeal suture lightly impressed, bisinuate; clypeus slightly emarginate at center of apex, faintly reflexed, angles rounded, surface densely punctured; antennal club slightly shorter than funicle. Thorax with sides broadly rounded, crenulate, angles obtuse, disk coarsely sparsely and rather regularly punctured. Elytra densely punctured, rugose, sutural costae elevated. Pygidium flattened, coarsely rugose, moderately and densely punctured, glabrous except for a few erect hairs at the rounded apex. Abdomen finely and moderately densely punctured, the punctures with short hairs; apical half of segment 5 with a raised rounded lobe reaching to apical border, the surface of which is granular-strigose, its apex finely serrate; segment 6 rather deeply and transversely sulcate, the apical and basal margins carinate. Posterior spurs free, elongate.

Female.—Antennal club equal to segments 3–7 combined; abdomen convex, sparsely setigerously punctate, segment 5 longer than 4, slightly tumescent in apical half, densely and coarsely punctured; segment 6 one-half the length of 5, densely punctured; otherwise similar to male.

Length, 12–14 mm. Width, 5.5–6 mm.

Remarks.—Most of the specimens examined are from Arizona: Fort Huachuca, Fort Grant, and Ramsey Canyon, all taken in July. I have also in my collection a male from Bakachaka, Rio Mayo, Sonora, Mexico, taken in July by my friend Howard Gentry.

Closely related to *P. sonora* Saylor but may be separated by the puncturing of the head and clypeus, as well as by the male sexual characters.

PHYLLOPHAGA (PHYTALUS) SONORA, new name

PLATE 9, FIGURE 6*d*; PLATE 10, FIGURES 6*a*–6*c*

Phytalus debilis HORN, Trans Amer. Ent. Soc., vol. 12, p. 122, 1885 (not LeConte, 1856).

Male.—Highly polished, glabrous, rufotestaceous, varying at times almost to piceous. Head with front coarsely and moderately densely punctured, the punctures shallow, more or less umbilicate, usually separated by one to two times their diameters, a large impunctate area on vertex; clypeal suture impressed, strongly biarcuate; clypeus wide, relatively flat, apex narrowly emarginate, slightly reflexed, disk coarsely and sparsely punctured. Antennal club longer than funicle. Thorax with sides entire, obtusely rounded at middle, slightly sinuate behind, front and hind angles obtuse, the latter prominent; disk regularly punctured, the punctures separated by one to three times their diameters. Elytra sparsely and shallowly punctured. Pygidium flattened, sides slightly concave, very sparsely punctured, glabrous except for a few erect hairs on margin near the subtruncate apex. Abdomen slightly flattened and very sparsely punctured at middle; posterior half of segment 5 at center with a raised granulate lobe, the latter not quite reaching the apical margin of the segment, segment 6 narrowly and transversely impressed, with a row of cilia along apical margin. Posterior spurs free.

Female.—More robust, clypeal suture more deeply impressed, faintly biarcuate; pygidium just before apex with a smooth slightly raised area, the apex of which has a single row of rather large punctures, each with a long erect hair; spurs long, apices rounded; abdomen convex, with segment 5 finely punctured in apical half, segment 6 somewhat transversely impressed at base, sparsely punctured, apex ciliate; the 10-segmented unicolorous, dark antennae with the club elongate, equal to segment 3–7 combined; hind femora quite broad; otherwise similar to male.

Length, 10–14 mm. Width, 5.5–6 mm.

Remarks.—Most of the material is from Arizona: Tucson, Carr Canyon, Globe, Patagonia, and Badger, taken in June, July, and August. I have a dozen examples in my collection from Mexico, all collected in Rio Mayo, Sonora, by Howard Gentry, at Sierra Charuca (July), San Bernardo (July), and Vinaterio (June). The species has not been recorded from Mexico before.

A not uncommon species of which the female has apparently not previously been recognized. In my collection is one individual of that sex from San Bernardo, Mexico (Gentry), from which the diagnosis has been drawn. The male pygidium may vary from almost flat to rather strongly convex. In some few examples, the sides of the thorax are very finely crenulate.

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NEW SPECIES OF POLYCHAETE WORMS OF THE GENUS EUPHROSYNE, WITH NOTES ON EUPHROSYNE BOREALIS ØRSTED

By Aaron L. Treadwell

In a recent paper (Treadwell, 1937, p. 25) I identified as *Euphrosyne borealis* Ørsted some annelids collected in Greenland by Capt. Robert A. Bartlett. Later comparison of these with other members of the genus led me to question the accuracy of this identification, and through the kindness of Dr. Waldo L. Schmitt I have had opportunity to examine all specimens of this genus in the collections of the United States National Museum. These were all labeled *Euphrosyne borealis*, but it appears that three species are represented.

Euphrosyne differs from the other members of the family Amphinomidae in that the neuropodia and notopodia are fused into a continuous ridge running from the ventrolateral border to the dorsal surface, leaving more or less of the middorsal region uncovered. The only species hitherto described from the northeastern coast of North America is *E. borealis* Ørsted (1842, p. 113). Ørsted's description is very brief, and the only addition to his account that I know is that of McIntosh (1885, pp. 5–6; pl. 1, figs. 2, 3; pl. 1A, figs. 4–6), who corrected Ørsted's statement that there are no dorsal cirri and gave some figures of the setae. To this account a few details may now be added.

Genus EUPHROSYNE Savigny

EUPHROSYNE BOREALIS Ørsted

FIGURE 46, *a*, *b*

Euphrosyna borealis ØRSTED, 1842, p. 113.

Body oval in outline; length 14 mm, width 7 mm. The parapodial ridge is thickly set with setae and gills, the tips of the dorsal setae in each somite overlapping those of the opposite side, their bases leaving a median dorsal clear space hardly wider than one-eighth of the body diameter. The caruncle (fig. 46, *a*) extends onto the fourth setigerous somite and has three longitudinal lobes, the median covering the laterals. At the anterior end of the caruncle lie the posterior eyes, overlapped by the basal portion of the median tentacle. This tentacle has a thickened, oval, basal portion that abruptly narrows distally into a slender process about one-third as long as the basal. An anterior pair of eyes lies on the ventral face of the prostomium and is not visible from above. In none of my material was I able to demonstrate the anterior paired tentacles that should lie at the level of the anterior eyes. In the other species these were easily seen. (See *E. branchiata* below.) The dorsal cirrus is sometimes difficult to see since it varies greatly in size. It is slender and, as noted by McIntosh (1885, p. 6), is fastened to the body wall almost in contact with the base of the dorsalmost gill (fig. 46, *b*). The ventral cirrus is much larger and lies near the ventral end of the seta row, its base surrounded by the ventralmost setae. In two somites taken at random there were six and seven gills in a single row on the parapodial ridge of one side of the body. Some of these were single filaments, but others may be 2-, 3-, or 4-branched (fig. 46, *b*). Ørsted described them as "bi-tripartitis." In the figure the dorsal cirrus is shown at the base of the gill.

The ventralmost setae form a prominent tuft in which those nearest the ventral surface are the shortest. Dorsal to the tuft the setae are shorter and continue of uniform width to the end of the ridge. The setae are as figured by McIntosh (1885, pl. 1A, figs. 4–6).

EUPHROSYNE BRANCHIATA, new species

FIGURE 46, *c–f*

Description.—Body length 6–7 mm; width 2–3 mm. The body is elongate-oval in outline and somewhat less shaggy in appearance than others of this genus. The ventral setae are longer than the dorsal and extend to a considerable distance from the body. Dorsal to this tuft of ventral setae the others are much shorter, hardly longer than the gills. The caruncle extends to the fourth somite, and the median

tentacle is about one-fourth as long as the caruncle. It is of uniform width throughout, lacking the slender terminal portion of *E. borealis* (fig. 46, *c*). The two pairs of eyes are situated as in *borealis*, and near the ventral pair are two slender tentacles. From a dorsal view only the tips of these tentacles are visible.

On the dorsal surface a clear space of about one-third the body width separates the upper ends of the parapodial ridges. At the ventral end of the ridge is a ventral cirrus with a tuft of long setae just dorsal to it. There follow rows of shorter setae with gills interspersed among them, and a dorsal cirrus is at the dorsal end of the row. In one row there were five gills, but I cannot say whether this

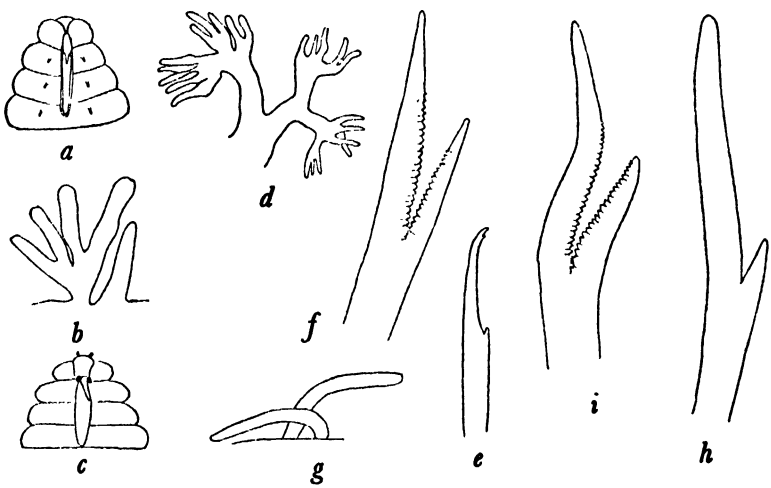


FIGURE 46.—Species of EUPHROSYNE

a, b, Euphrosyne borealis Ørsted: *a*, Anterior end, x 6; *b*, gill and dorsal cirrus, x 22.5.
c–f, Euphrosyne branchiata, new species: *c*, Anterior end, x 7.5; *d*, gill, x 68; *e*, small seta, x 250; *f*, large dorsal seta, x 250.
g–i, Euphrosyne longisetis, new species: *g*, Gill, x 22.5; *h*, smaller seta, x 185; *i*, larger seta, x 185.

number is constant in all somites. The gills (fig. 46, *d*) are complexly branched and about as long as the setae. The long setae of the ventral tuft very considerably in width and in the size of the larger tooth but are all alike in general structure. At some distance from the apex is a sharp tooth followed by a narrowing to the curved, sharp apex. Just behind the apex is a very small, slender tooth (fig. 46, *e*). In the row with the gills are shorter but heavier setae, which are hardly longer than the gills. They vary in size, but all have the general outline shown in figure 46, *f*. Some are smooth beyond the fork; others have the marginal lobing shown in the figure.

Type.—U.S.N.M. no. 20412. Collected by the U. S. S. *Albatross* at station 2265, October 18, 1884, at latitude 37°07′40″ N., longitude 74°35′40″ W., in 70 fathoms.

Remarks.—In the character of the gills and setae this species agrees closely with *E. armadillo* Sars as described by McIntosh (1900, pp. 238–240, pl. 35, figs. 2, 8–14), and possibly it may be that species. McIntosh described the median tentacle as biarticulate, by which I assume he meant like that figured for *E. borealis*, but in the present specimens the terminal slender portion is not present. Also, the subterminal fine tooth on the seta is larger than is shown in McIntosh's figure.

EUPHROSYNE LONGISETIS, new species

FIGURE 46, *g–i*

Description.—Caruncle and median tentacle much as in *E. borealis*, except that in the tentacle the basal portion is much shorter and the terminal narrow part relatively much longer than *borealis*. The setae are of more uniform width than in other species and extend to a greater distance from the body surface. It differs also from *E. borealis* in that the middorsal naked strip is much wider, being about as wide as one-third of the body width. In this respect it resembles *E. branchiata*. The gills are cirruslike processes of uniform diameter and generally unbranched (fig. 46, *g*), but in larger individuals a few may have two or three branches. On the parapodial ridge of one half somite there were six of these gills. Most of the setae are as shown in figure 46, *h*, having a conical subterminal tooth and the end of the seta blunt. In the dorsal part of the row the setae are as shown in figure 46, *i*, differing only slightly from those of *E. borealis*.

There is some difference in length between the ventral and the dorsal setae, this being more marked in large than in small individuals.

Type.—U.S.N.M. no. 338; labeled as collected in Greenland by Dr. Charles Lütkens. It is 15 mm long and 5 mm wide.

Remarks.—This species is the commonest of the genus in the National Museum collections. It is recorded as taken in Massachusetts Bay; off Head Harbor (probably U. S. Fish Commission station x, Aug. 2, 1872, Bay of Fundy, 2½ miles about southeast of Head Harbor Light, Campobello Island, 90 fathoms); Banquereau; and east end of Cobourg Island, Baffin Bay, latitude 75°40′ N., longitude 78°50′ W.

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NOTES ON THE BIRDS OF TENNESSEE

By ALEXANDER WETMORE

IN continuation of studies begun last year in the east-central group of States, to secure needed material in birds and mammals for the United States National Museum, we conducted field work through the season of 1937 in the State of Tennessee. As in West Virginia in 1936, W. M. Perrygo of the National Museum was in charge of the field party; Carleton Lingebach assisted during the spring and Henry R. Schaefer during the fall. Traveling in a small truck, the party left Washington on April 3 and continued in the field until July 17, when work was terminated for the summer. In fall field work began on September 9 and continued to November 11.

The following account presents in sufficient detail the results of studies of the birds obtained. A similar statement[1] covering the mammals has been prepared by Dr. Remington Kellogg, assistant curator of mammals in the United States National Museum.

In addition to remarks on the specimens obtained in 1937, I have included throughout this report reference to other skins from Tennessee in the National Museum so far as these have come to attention. Most of these were collected by W. H. Fox near Chattanooga and on Lookout Mountain in 1882 and near Rockwood in Roane County in the spring seasons of 1884 and 1885. Fox published only a few records from the Lookout Mountain area,[2] but he gave a complete list of his observations in the latter region.[3] It has seemed desirable to include his specimens so far as they have been found in order to

[1] Proc. U. S. Nat. Mus., vol. 86, no. 3051.

[2] Stray notes from Lookout Mountain, Tenn. Bull. Nuttall Orn. Club, 1882, pp. 191–192.

[3] List of birds found in Roane County, Tennessee, during April, 1884, and March and April, 1885. Auk, 1886, pp. 315–320; 1887, p. 164.

bring their identification up to date, in view of the long period that has elapsed since his notes were published. Included also are notes on a few specimens from northeastern Tennessee collected by A. H. Howell in 1908 and 1910.

All the data assembled are made available here for the use of those working on the list of birds of the State or occupied in other ways with the birds of Tennessee. I have not attempted to make an exhaustive search of literature for State records, as that is the province of those engaged on a complete report of all the birds that have been found in Tennessee. The notes include some records based on observations where specimens were not taken.

Tennessee is so located geographically that it covers an area where there is intergradation between a number of forms, so that handling the present collection has been interesting and, in part, difficult. That a region of mergence is covered should be borne in mind in reading the following notes, as otherwise some of the statements may be misunderstood. Assignment of names has been made only after careful consideration of the characters found in the individual specimens.

Our work was carried on under permits granted by Howell Buntin, Director of Game and Fish, Department of Conservation of Tennessee. We are deeply indebted to Mr. Buntin for his cooperation and to the officers under his direction throughout the State, who were uniformly of assistance. The National Park Service courteously granted permission for work in the Great Smoky Mountains National Park, where our party had the friendly assistance of J. R. Eakin, superintendent, and of Arthur Stupka, park naturalist. Arrangements for investigations in the Unaka National Forest were made through the courtesy of J. B. Spring, district forest ranger at Bristol, and in the Cherokee National Forest through J. W. Cooper, district forest ranger at Cleveland.

Everywhere in Tennessee our party had friendly reception from citizens and landowners, who aided in many ways, particularly in granting permission to enter on their lands. We are much indebted for this assistance, without which the work would not have been possible.

ITINERARY

The collecting work was planned so as to cover the different sections of Tennessee as completely as possible in the time available. As stated above, the party had a small truck for transportation. Work began in the southwestern corner of the State with headquarters at Ellendale, not far from Memphis, and covered Shelby and western Fayette Counties during the period from April 8 to 22. Important collections were made in a large area of cypress swamp near Hickory Withe, where permission for hunting over an exten-

sive tract was courteously afforded by A. Weber. On April 23 the party moved to a new base near Union City to remain until May 8, collecting principally in the region adjacent to Reelfoot Lake. Through permission of the State authorities these investigations covered the lake and that part of the adjacent shore included in the State reserve. Dr. Herbert Friedmann joined the party here from May 2 to May 5.

On May 9 Perrygo moved to Waynesboro, where collections were made until May 19 in a region of forested hills extending 10 miles to the north and covering sections on the Green River and near Flat Woods on the Buffalo River.

The party then moved to a point near Crossville, on the Cumberland Plateau. Collections were made here until May 31 over a considerable area, mainly on Birds Creek and near Pikeville and Melvine. The men then proceeded to the mountainous area of eastern Tennessee, and on June 1 through the friendly permission of Roy P. Blevins made camp on a grassy area above Beaverdam Creek behind the post office at Shady Valley. From this camp, at 2,900 feet elevation, there was easy access to the Holston Mountains on the west and to the Iron Mountains on the east, while to the south collections were made on Cross Mountain and in the valley to the south as far as Carter. I joined the party here from June 5 to 8. Perrygo and Lingebach remained in this region until June 16.

On June 17 the men drove south to Gatlinburg in the Great Smoky Mountains National Park, where through arrangements made by J. R. Eakin, park superintendent, and Arthur Stupka, park naturalist, they located next day at a camp 4½ miles southwest of Cosby at an elevation of 2,700 feet, a point highly advantageous for the work in hand. From here studies were made on Cosby Knob, White Rock, Inadu Knob, Snake Den Mountain, Old Black Mountain, and Mount Guyot, the work extending to elevations of 6,600 feet. Much valuable and important material was obtained, the work continuing until July 5. Mount Guyot proved most fruitful for Canadian Zone birds.

On July 6 camp was made at Ocoee in the Cherokee National Forest, through the kind permission of the district forest ranger, J. W. Cooper. In this region collections were made on Big Frog Mountain to elevations of over 4,000 feet, and on the dry, pine-covered slopes of Beans Mountain. Birds were most abundant between 1,800 and 3,000 feet. The party broke camp for the return to Washington on July 16.

In fall Perrygo left Washington on September 9, accompanied by Henry R. Schaefer, and on the following day called on the district forest ranger in Bristol, Tenn., to arrange permission for work on the lower slopes of Roan Mountain. That afternoon they drove up the

mountain, with some difficulty due to wet and slippery roads, and camped at 6,200 feet elevation. On September 13 camp was moved to the eastern side of the summit, and two days later the men secured a cabin as a necessary shelter from the almost constant fog and rain. While through force of circumstances the camp was located across the State boundary in North Carolina, all collections were made in Tennessee. There was much migration movement among the smaller birds here, black-throated blue warblers and red-eyed vireos being particularly abundant. Birds were obtained from altitudes of 4,200 feet below Carvers Gap to 6,200 feet across the summit of the mountain. After the extreme heat of the lowlands the cool air of this high mountain was almost reminiscent of winter.

On September 25 the men moved down to Elizabethton and the following day established a base near Bean Station 12 miles northeast of Rutledge in Grainger County for work in the Clinch Mountains. This area proved to be rather dry, with a mixed second-growth forest of pine and hardwood, with little of note except a considerable migration of wood warblers. Collections were made here until October 2. The following two days were occupied in driving across to Reelfoot Lake, where on October 4 the party located in a cabin on the western shore of the lake, 4 miles northeast of Tiptonville. Plans called for work here until October 23 to follow the fall migration, but results were less than had been expected as birds were only fairly common and often hard to find because of strong winds that made them seek cover. Trips were made on the lake by means of boats, and the western and southern shore lines and adjacent regions were covered from near Samburg around to Ridgely. They also worked along the Hickman-Reelfoot Levee near the Mississippi River.

From October 24 to 31 the party located in the tobacco-growing section at Clarksville, collecting along the Cumberland River near Dover and Indian Mound and also working in heavy woods north of the latter point. On November 1 the work was transferred to a farming section in Lincoln and Giles Counties with headquarters at Fayetteville. Most of the specimens secured here were obtained in the vicinity of Pulaski and of Frankewing, near where there is a considerable tract of heavy timber. Work terminated on November 10, and the following day the party reached Washington.

Family COLYMBIDAE

PODILYMBUS PODICEPS PODICEPS (Linnaeus): Pied-billed Grebe

An adult female was taken on May 14, 1937, on the Green River about 8 miles north of Waynesboro, Wayne County. It does not seem probable that the bird was on its breeding grounds, as suitable

cover for nesting was not available. On October 8 an immature female, with the streakings on the head of the juvenile plumage, was shot on Reelfoot Lake about 6 miles northeast of Tiptonville. Others were seen here on October 21. A bird only recently hatched was taken on Reelfoot Lake on May 25, 1938.

Family PHALACROCORACIDAE

PHALACROCORAX AURITUS AURITUS (Lesson): Double-crested Cormorant

Common on Reelfoot Lake, where 12 were seen on May 7. Many were recorded from October 6 to 21. A female in brown plumage, taken 6 miles northeast of Tiptonville on October 8, is typical in size of the larger, northern race, having the following measurements: Wing 311, tail 140, culmen from base 56.2, and tarsus 64.8 mm.

Family ANHINGIDAE

ANHINGA ANHINGA (Linnaeus): Water-turkey

On Reelfoot Lake two were seen on April 26 and another on May 1.

Family ARDEIDAE

CASMERODIUS ALBUS EGRETTA (Gmelin): American Egret

Observed at Reelfoot Lake from April 24 to May 7 and from October 5 to 22.

BUTORIDES VIRESCENS VIRESCENS (Linnaeus): Eastern Green Heron

Observed as follows: Hickory Withe, April 14; Eads, April 21; Hornbeak, May 4; Reelfoot Lake, 6 miles northeast of Tiptonville, October 6; Waynesboro, May 13 and 18; Pikeville, May 31; Rogersville, June 1; Shady Valley, June 3 to 9.

NYCTICORAX NYCTICORAX HOACTLI (Gmelin): Black-crowned Night Heron

Recorded at Reelfoot Lake April 30, May 7, and October 5.

BOTAURUS LENTIGINOSUS (Montagu): American Bittern

One seen at Reelfoot Lake May 6.

IXOBRYCHUS EXILIS EXILIS (Gmelin): Eastern Least Bittern

On Green Island, Reelfoot Lake, two were seen on May 7, and a female was taken.

Family ANATIDAE

QUERQUEDULA DISCORS (Linnaeus): Blue-winged Teal

Six seen on Reelfoot Lake on October 21.

AIX SPONSA (Linnaeus): Wood Duck

Seen regularly at Reelfoot Lake from April 29 to May 7 and October 6 to 21.

Family CATHARTIDAE

CATHARTES AURA SEPTENTRIONALIS Wied: Eastern Turkey Vulture

The turkey vulture was observed regularly though not in great abundance in all the localities where collections were made from the Mississippi River to the mountains along the eastern border. On October 24 a flock of 34 passed traveling south, evidently in migration. Three specimens taken, all females, one from Hickory Withe, Fayette County, April 10, and two from near Ridgely, Lake County, October 15, have the measurements assigned to the eastern form as defined by Dr. Friedmann,[4] the wings being 530, 532, and 538 mm, and the tails 279, 283, and 287 mm.

CORAGYPS ATRATUS (Meyer): Black Vulture

Records for the black vulture are as follows: Eads, April 21; Ellendale, April 19; Reelfoot Lake, April 29, October 12–19; Union City, May 24; Pulaski, November 1–4; Frankewing, November 8; and Crossville, May 24. None were recorded from the higher elevations of the eastern mountain section, though the species is found there on occasion.

On October 12 a male was taken near Phillippy, Lake County, in the vicinity of Reelfoot Lake. This bird has a wing measurement of 415 mm. Friedmann,[5] through examination of considerable material, has confirmed the impression of other workers that there is no appreciable difference in size between the black vultures of North America and of South America, so that subspecies in this group cannot be recognized. In the A. O. U. Check-list for 1931 this bird is listed as *Coragyps atratus atratus*.

Family ACCIPITRIDAE

ACCIPITER STRIATUS VELOX (Wilson): Sharp-shinned Hawk

Seen at Reelfoot Lake on October 16; Union City, April 30; Indian Mound, Cumberland River, October 29; near Bean Station on Clinch

[4] Proc. Biol. Soc. Washington, vol. 46, Oct. 26, 1933, p. 188.
[5] *Ibid.*, pp. 187–188.

Mountain, September 27; in Shady Valley, June 9 (one chasing a quail); and at 6,000 feet elevation on Roan Mountain September 13 and 14.

As the sharp-shinned hawk of the United States is conspecific with the West Indian races, it must bear the specific designation *striatus* of Vieillot as indicated above, since this name antedates in publication *velox* of Wilson. It is given in the A. O. U. Check-list for 1931 as *Accipiter velox velox* through error.

ACCIPITER COOPERII (Bonaparte): Cooper's Hawk

A common species, recorded at Ellendale, April 20; Hickory Withe, April 9; Reelfoot Lake, April 29 and October 7; Tiptonville, October 18; 12 miles northwest of Waynesboro, May 13; near Pulaski, November 2 and 3; Crossville, May 28; Shady Valley, June 3 and 5; Roan Mountain, September 13 and 22; and 4 miles southeast of Cosby, June 29.

BUTEO JAMAICENSIS BOREALIS (Gmelin): Eastern Red-tailed Hawk

Recorded as follows: Ellendale, April 7 (partial albino); Samburg, October 18; Tiptonville, October 20; Waynesboro, May 16; Pulaski, November 2; Fayetteville, November 3; Frankewing, November 4; Birds Creek near Crossville, May 26; 3 miles north of Pikeville, May 28; Clinch Mountain, west of Bean Station, September 27 and 28; 6 miles northeast of Shady Valley, June 3; Roan Mountain, September 20 and 23; Great Smoky Mountains, southeast of Cosby, June 19, 21, and 27, and Inadu Knob, a pair from June 25 to 29; Big Frog Mountain, July 10. Listed in the A. O. U. Check-list for 1931 as *Buteo borealis borealis*.

BUTEO LINEATUS LINEATUS (Gmelin): Northern Red-shouldered Hawk

The red-shoulder was fairly common, being recorded at the following points: Frayser, April 8; Hickory Withe, April 12 to 22 (three taken); near Reelfoot Lake, April 24 to May 5 and October 7 to 20; Dover, October 30; Pulaski, November 3; Melvine, May 21; and Kingston, June 1.

The three specimens secured at Hickory Withe, Fayette County, on April 12, 13, and 15 include one male and two females. These are somewhat intermediate toward the southern form *Buteo lineatus alleni* but appear decidedly nearer to true *lineatus* and are identified as that subspecies. Measurements are as follows: Male, wing 309, tail 203, culmen from cere 20.4, tarsus 78.3 mm; two females, wing 331, 327, tail 206, 199, culmen from cere 23.3, 23.3, tarsus 81.5, 82.1 mm.

The male is within the minimum range of *lineatus* and the maximum of *alleni*. The crown is slightly grayer than most *lineatus* but is definitely browner than typical *alleni*. The back is well marked with brown, agreeing with *lineatus*, while below the bird is light, as in *alleni*. Both females are definitely like *lineatus* above and both are darker below than the male. Their measurements, while within the maximum for *alleni*, are larger than the average for that form.

The birds from Hickory Withe were on their breeding grounds, and may be considered representative of the species from that region.

BUTEO PLATYPTERUS PLATYPTERUS (Vieillot): Broad-winged Hawk

Seen near Waynesboro, May 10, and 10 miles east of Pulaski, November 2. In the mountain area one was recorded 4 miles southeast of Cosby on June 29, and others at 2,000 feet elevation on Big Frog Mountain on July 10 and 15. An immature was taken on July 10, 8 miles southwest of Copperhill on Big Frog Mountain.

AQUILA CHRYSAËTOS CANADENSIS (Linnaeus): Golden Eagle

On Roan Mountain one was seen over the summit on September 12 and another on September 14.

HALIAEETUS LEUCOCEPHALUS LEUCOCEPHALUS (Linnaeus): Southern Bald Eagle

On April 29 a bald eagle was seen at Reelfoot Lake, and a nest that may have been abandoned was recorded. In fall one or two were observed regularly from October 6 to 23.

CIRCUS CYANEUS HUDSONIUS (Linnaeus): Marsh Hawk

Seen at Reelfoot Lake, October 5, 19, and 21; Huntingdon, April 7; Dover, October 26 and 30; and near Pulaski, November 2 and 4. In Carvers Gap on Roan Mountain two were seen daily from September 13 to 23, feeding over the grassy bald and occasionally flying over the low spruces.

While given in the fourth edition of the A. O. U. Check-list (1931) as *Circus hudsonius*, current usage today recognizes the North American marsh hawk as a geographic race of the Old World hen-harrier, *Circus cyaneus*. The difference between these two is found in the more heavily spotted under surface in the adult male of the American bird (this being regularly without spots in *cyaneus*) and in the darker coloration of the female and immature. The two are quite distinct but seem so allied as to belong to the same specific group.

PANDION HALIAETUS CAROLINENSIS: Osprey

An osprey was seen on Reelfoot Lake on October 7 and another 3 miles north of Waynesboro on May 12.

Family FALCONIDAE

FALCO PEREGRINUS ANATUM Bonaparte: Duck Hawk

Near Walnut Lodge on Reelfoot Lake, October 14, a duck hawk swooped repeatedly at a barred owl. In the Great Smoky Mountains one was recorded on Mount Guyot at 6,300 feet on June 29 and another on Inadu Knob at 5,700 feet on June 30. One was noted at 6,200 feet on Roan Mountain, September 16.

FALCO SPARVERIUS SPARVERIUS Linnaeus: Eastern Sparrow Hawk

The only sparrow hawk obtained was a male collected at an elevation of 2,150 feet on Beans Mountain, 2½ miles northeast of Parksville, Polk County, on July 13, 1937. This bird has the wing 183, tail 109.5, culmen from cere 12.5, and tarsus 37 mm. The breast is nearly immaculate, but there are scattered spots over the abdomen. There is also in the National Museum a female, taken by W. H. Fox on Lookout Mountain, March 31, 1882, that held an egg ready to be laid. This bird has the following measurements: Wing 183, tail 114, culmen from cere 13.5, tarsus 34.4 mm. In short tail and fine streaking of under surface this bird shows some approach to *paulus* but is considered to represent *sparverius*.

Interesting sight records by Perrygo include a sparrow hawk at 3,700 feet in the Great Smoky Mountains, June 21; two on Big Frog Mountain near Copperhill, July 8; and others on Roan Mountain at 5,900 feet on September 12 and at 5,500 feet on September 13.

Family TETRAONIDAE

BONASA UMBELLUS TOGATA (Linnaeus): Canada Ruffed Grouse

Three specimens taken include one from Shady Valley, June 4; one from 6,300 feet elevation on Roan Mountain, September 25; and one from 6,600 feet on Mount Guyot in the Great Smoky Mountains, June 21. All these display the heavily barred under parts and the amount of brown in the under tail coverts that characterize this race.[6]

[6] See Wetmore, Proc. U. S. Nat. Mus., vol. 84, 1937, pp. 406–407.

In addition to the specimens listed the ruffed grouse was recorded by Perrygo as follows: One was heard 5 miles east of Crossville on Birds Creek on May 28 and another in the Clinch Mountains 6 miles southwest of Bean Station on September 29. In the Holston Mountains above Shady Valley grouse were common in June, and females with young were recorded from June 11 to 15. On June 6 on Iron Mountain I saw two females with young, one brood of half a dozen being as large as quail. In the Great Smoky Mountains Perrygo found two broods on Cosby Knob at 5,000 feet on June 19 and recorded others on Mount Guyot, June 21, on Snake Den Mountain, June 23, and on Inadu Knob, July 2. Two were drumming on July 13 at 2,100 feet on Big Frog Mountain.

Family PERDICIDAE

COLINUS VIRGINIANUS VIRGINIANUS (Linnaeus): Eastern Bobwhite

Recorded at many localities. An adult male was taken at Shady Valley on June 10.

Family MELEAGRIDIDAE

MELEAGRIS GALLOPAVO SILVESTRIS Vieillot: Eastern Turkey

One seen at 6,100 feet on Old Black Mountain in the Great Smokies on June 27.

Family RALLIDAE

GALLINULA CHLOROPUS CACHINNANS Bangs: Florida Gallinule

On Reelfoot Lake an adult and an immature gallinule were taken on October 6, and nine others were seen on October 21.

FULICA AMERICANA AMERICANA Gmelin: American Coot

On Reelfoot Lake three coots were seen on April 26 and eight on May 7. In fall they were common from October 6 to 21, specimens being taken October 6 and 8.

Family CHARADRIIDAE

OXYECHUS VOCIFERUS VOCIFERUS (Linnaeus): Killdeer

A male was taken at Hornbeak, Obion County, on May 4. Another was collected by W. H. Fox at Rockwood on March 9, 1885.

While the killdeer is evidently allied to the plovers usually placed in the genus *Charadrius*, the decidedly longer and more graduated tail and the distinct color pattern seem to me to warrant its separation

in a distinct genus, instead of listing it in *Charadrius* as proposed by Peters.[7]

Family SCOLOPACIDAE

PHILOHELA MINOR (Gmelin): American Woodcock

One was observed in Shady Valley on June 11 and another at 5,000 feet elevation on Cosby Knob, in the Great Smoky Mountains, on June 19.

CAPELLA DELICATA (Ord): Wilson's Snipe

One was seen 6 miles east of Pulaski on November 4. There is one in the National Museum taken at Rockwood, March 9, 1885, by W. H. Fox.

TRINGA SOLITARIA SOLITARIA Wilson: Eastern Solitary Sandpiper

Solitary sandpipers were seen near Phillippy on April 27 and near Reelfoot Lake on April 29. On April 15 near Hickory Withe three were seen and two were shot, one being the eastern form, a female with a wing measurement of 134 mm. A specimen collected by W. H. Fox at Rockwood on April 22, 1885, with a wing of 135.4 mm, is also the eastern form, though slightly intermediate.

TRINGA SOLITARIA CINNAMOMEA (Brewster): Western Solitary Sandpiper

A female taken in company with one of the eastern race 3 miles west of Hickory Withe, Fayette County, April 15, has the following measurements: Wing 140.5, tail 61.3, culmen from base 32.5, and tarsus 31.9 mm. In addition to large size this specimen has the white spottings on the back reduced and the inner web of the outermost primary distinctly marbled with whitish.

This western race must be considered only casual in its occurrence so far east of its normal range.

Family COLUMBIDAE

ZENAIDURA MACROURA CAROLINENSIS (Linnaeus): Eastern Mourning Dove

The widely distributed mourning dove was recorded in all the areas visited both in spring and in fall. Specimens identified as the eastern form *carolinensis* were collected 2 and 8 miles north of Waynesboro, May 12 and 13; near Rockwood, April 8, 1884 (taken by W. H. Fox);

[7] Check-list of birds of the world, vol. 2, 1934, pp. 252–253.

and 3 miles north of Pikeville, Bledsoe County, May 21. The last is an immature male in juvenal dress. An immature male, supposed to be a migrant from farther north, was secured 7 miles northeast of Tiptonville, Lake County, October 20, 1937. The eastern race appears to be the breeding form of Tennessee except in the extreme west. It is almost certain that it extends clear to the Mississippi River from fall until the opening of spring, as in that period many northern migrants invade the State.

ZENAIDURA MACROURA MARGINELLA (Woodhouse): Western Mourning Dove

A pair of mourning doves taken 4 miles southeast of Hickory Withe, Fayette County, on April 20 show definitely the paler color above and below that characterizes the western form. A male secured at Hornbeak, Obion County, May 4, also belongs here though slightly darker in color and therefore somewhat intermediate toward the eastern bird. An immature male taken 7 miles northeast of Tiptonville in Lake County on October 20 is also somewhat intermediate, being darker on the dorsal surface, but it is nearer *marginella*. Apparently the western bird is the mourning dove of the extreme western part of Tennessee, in the northwest intergrading with *carolinensis*, the eastern race. Further details as to the range of *marginella* will be of interest, especially with regard to specimens that are definitely breeding.

Family CUCULIDAE

COCCYZUS AMERICANUS AMERICANUS (Linnaeus): Yellow-billed Cuckoo

The first one of the season was collected on May 1 near Hornbeak, Obion County. In fall another was secured and others were seen on October 18 near Tiptonville. Near Waynesboro yellow-billed cuckoos were common from May 10 to 18, and two were taken. Others were found near Pikeville on May 28 and 31 (one collected on the latter date). They were recorded at 2,700 feet elevation near Cosby on June 25, at 2,000 feet on Big Frog Mountain on July 14, and on the same day at 2,900 feet on Beans Mountain near Parksville, where one was taken.

COCCYZUS ERYTHROPTHALMUS (Wilson): Black-billed Cuckoo

The two specimens taken of this cuckoo include a female from Obion County near Reelfoot Lake on April 30. Others were seen in this area near Hornbeak on May 6 and on Caney Island on May 7. Another female was shot 4 miles east of Waynesboro on Buffalo

River, May 17. One was recorded from Low Gap near Cosby in the Great Smoky Mountains on June 19.

Family STRIGIDAE

OTUS ASIO ASIO (Linnaeus): Southern Screech Owl

A male taken 6 miles east of Frankewing in Lincoln County on November 9, with a wing measurement of 150 mm, belongs to the southern race, as defined by Bangs.[8] A female collected on Lookout Mountain on March 20, 1882, by W. H. Fox, has a wing measurement of 160 mm and is also this form. On this basis the southern screech owl has a more extensive range through the southern section of Tennessee than has been supposed.

BUBO VIRGINIANUS VIRGINIANUS (Gmelin): Great Horned Owl

On September 20 a male was secured at 5,500 feet elevation in Carvers Gap on Roan Mountain. This species is not included in A. F. Ganier's list of the birds of Roan Mountain.[9]

STRIX VARIA VARIA Barton: Northern Barred Owl

A male taken at Shady Valley on June 7 and a female from 3,500 feet elevation on Snake Den Mountain (Cocke County) in the Great Smoky Mountains have the feathering on the toes extending down past the middle of the final joint, as is characteristic of the northern race. It is supposed that others heard or seen at 5,000 feet on Roan Mountain on September 22 and on Cosby Knob (5,000 feet), Inadu Knob (5,700 feet), and near Cosby (2,700 feet) between June 19 and June 29 were of this same race.

One heard on Big Frog Mountain is of doubtful status.

STRIX VARIA GEORGICA Latham: Florida Barred Owl

Two young barred owls about two-thirds grown, taken near Eads, Shelby County, on April 20, have the distal joints of the toes entirely bare except for a narrow line of feathers down the side of the central toe. These are characteristic of the southern form. An immature about three-quarters grown, secured near Hickory Withe, April 22, seems somewhat intermediate, as the feathering comes down nearly to the middle on the two lateral toes and to about one-third of the length of the middle toe with a line down the outer side. This seems somewhat intermediate but is nearer the southern bird. An adult male, taken 3 miles south of Ridgely in Lake County on October 14,

[8] Auk, 1930, p. 404.
[9] Migrant, 1936, pp. 83–86.

has the outer toe with the proximal third feathered and a line of feathers down the inner side nearly to the end, the distal joint of the middle toe bare except for a fairly heavy line down its outer side, and the inner toe bare for half the distal joint, being somewhat intermediate but nearer the southern bird. These owls were noted in the vicinity of Reelfoot Lake on April 26 and May 7 and from October 7 to 16. There is no question that Leon Kelso [10] is correct in indicating that *Strix georgica* of Latham [11] applies to the southern form of the barred owl, currently known as *Strix varia alleni* Ridgway.[12] In addition to the characters discussed by Kelso, it may be noted that Latham includes his *Strix georgica* in the group *Inauriculatae*, as distinguised from his *Auriculatae*, *pennis auriculatum instar extantium*, showing clearly that he was describing a smooth-headed bird.

Family CAPRIMULGIDAE

ANTROSTOMUS CAROLINENSIS (Gmelin): Chuck-will's-widow

Heard calling near Ellendale on April 20 and 1 mile east of Waynesboro on May 10 and 11.

ANTROSTOMUS VOCIFERUS VOCIFERUS (Wilson): Eastern Whip-poor-will

Specimens were taken 9 and 10 miles north of Waynesboro on May 11 and 12 and 4 miles south of Crossville on May 29. Whip-poor-wills were heard in Shady Valley from June 1 to 13, 4 miles southeast of Cosby at 2,700 feet elevation on June 24, and on Big Frog Mountain on July 14.

Family MICROPODIDAE

CHAETURA PELAGICA (Linnaeus): Chimney Swift

In the wilder sections of the Great Smoky Mountains from June 19 to 30 chimney swifts were found nesting in hollow trees on Mount Guyot, Inadu Knob, and Old Black Mountain. A male was taken near Cosby on June 19. On July 10 several pairs were observed about old trees at 3,700 feet elevation on Big Frog Mountain, and it was supposed that they were using them for nesting sites.

[10] Auk, 1933, pp. 106–107.

[11] *Strix Georgica* Latham, Supplementum indicis ornithologici, 1801, p. xv (southern Georgia).

[12] *Strix nebulosa alleni* Ridgway, Proc. U. S. Nat. Mus., vol. 3, 1880, p. 8 (Clearwater, Fla.).

Family TROCHILIDAE

ARCHILOCHUS COLUBRIS (Linnaeus): Ruby-throated Hummingbird

The first of the season was recorded at Hickory Withe on April 21. Two females were taken in Shady Valley on June 5 and 10.

Family ALCEDINIDAE

MEGACERYLE ALCYON ALCYON (Linnaeus): Eastern Belted Kingfisher

Observed at the following places: Hickory Withe, April 15; Reelfoot Lake, April 24 to May 6 and October 11 and 14; Beech Creek, 12 miles northwest of Waynesboro, May 13; Buffalo River, 4 miles east of Flat Woods, May 17; Pulaski, November 1.

Family PICIDAE

COLAPTES AURATUS AURATUS (Linnaeus): Southern Flicker

The southern race of the flicker, marked by smaller size, is found through the greater part of the State, ranging east at least as far as Crossville and in the southeast to Beans Mountain. Records of breeding birds assigned to this form (with the wing measurements given in millimeters in parentheses) are as follows: Frayser, 4 miles east of Memphis, April 8, female (148.6); Hickory Withe, April 9, female (146); 4 miles west of Hornbeak, Obion County, May 3, male (149), female (148.2); 8 miles north of Waynesboro, May 13, female (151, a little larger than the average); 7 miles southwest of Crossville, May 26, two males (148, 150.5).

The flickers of the eastern mountain section are somewhat puzzling. Those of Shady Valley are definitely the northern form *luteus*, as is shown in the following account of that form. However, an adult male taken at 5,000 feet elevation on Cosby Knob in the Great Smoky Mountains June 19, in fresh plumage with the wing not worn, measures only 149 mm. On the basis of size it is to be called *auratus* and may be either a specimen from a point where intergradation between the two birds begins or a wanderer from the nearby lowlands. In view of the strong flights made by flickers through mountain areas, the latter is possible. More specimens are needed from the Great Smoky Mountain area to determine the status of the bird in that section. A male taken on July 14 at 1,800 feet on Beans Mountain in the southeastern section of the State measures 148.5 mm. This mountain does not rise to high elevation. On the higher mass of Big Frog Mountain a little farther south and east the flicker population seems distinctly mixed, as in two females taken at 2,100 feet on July 15 the wing in one measures 149 mm, agreeing thus with *auratus*, while

in the other it is 156.5 mm, being well within the limit of *luteus*. Apparently the two forms are definitely in contact at this point, so a mixed population is present.

Specimens assigned to *auratus* taken in fall include a male from Tiptonville, October 6 (wing 150), and another from Frankewing, Lincoln County, November 3 (wing 150.2).

The male from Cosby Knob has a few red feathers in the black malar stripe near the center of the dorsal margin on either side. A male from Crossville has a few red feathers along the anterior edge of the stripe. Other males in the series secured have this mark entirely black.

COLAPTES AURATUS LUTEUS Bangs: Northern Flicker

In the material collected in 1937 the northern flicker is represented by breeding birds in specimens from the mountain area, along the eastern border of the State. Three birds from the vicinity of Shady Valley in Johnson County are definitely this form, a male taken on June 3 at 2,800 feet near the base of the Holston Mountains having a wing measurement of 154 mm and two females secured on June 5 at 2,900 feet elevation near Shady Valley post office measuring 159.5 and 154.5 mm. All three have the ends of the primaries considerably worn. Apparently it is near this point that the northern and southern birds begin to mix, as it will be recalled that one from Cosby Knob has the measurements of *auratus*. One female taken by Perrygo on Big Frog Mountain at 2,100 feet on July 15 has a wing measurement of 156.5 mm, equaling *luteus*, though another specimen secured the same day has the small size of *auratus*.

While *auratus* is indicated as the breeding bird at Hornbeak in Obion County, apparently *luteus* may extend across the northern border of the State from a short distance farther east, as a male collected by R. J. Thompson at Danville on the Tennessee River on June 29, 1892, has the wing 154 mm, and one secured by A. H. Howell at 3,400 feet elevation on Cross Mountain near the boundary of Anderson and Campbell Counties on August 15, 1908, measures 158.5 mm.

From fall to spring the northern form covers the entire State. Dates of interest in the specimens before me include a female from Hickory Withe, April 9 (155), and a female from 2,000 feet elevation in the Clinch Mountains, 3 miles west of Bean Station shot September 28 (wing 153). Possibly the latter is a representative of the breeding stock of its area. Others were obtained as follows: Reelfoot Lake, October 16; Samburg, October 11; Indian Mound, Stewart County, October 28; Pulaski, November 2; Lookout Mountain, March 24 and 25, 1882 (W. H. Fox); and Rockwood, March 15, 1885 (W. H. Fox).

COLAPTES AURATUS BOREALIS Ridgway[12]: Boreal Flicker

Though not included in the fourth edition of the A. O. U. Check-list in 1931, I can see no reason for not recognizing the boreal flicker of Ridgway, with a breeding range across the north from Labrador to Alaska and extending south from the northern limit of trees to the northern border of the United States from northern Minnesota to eastern Montana. The majority of the breeding birds from this area have wing measurements ranging from 160 to 171 mm, dimensions that are considerably more than those of *C. a. luteus* to the south. When birds of this maximum size occur in the south it is during fall, winter, and spring, when they may be assumed to be migrants from the north.

Two of these large northern birds are included in the collection from Tennessee—a male taken by W. H. Fox at Rockwood on April 1, 1885 (wing 164), and a female from Hickory Withe secured by Perrygo and Lingebach on April 12, 1937 (wing 164).

CEOPHLOEUS PILEATUS PILEATUS (Linnaeus): Southern Pileated Woodpecker

Specimens of this fine woodpecker were obtained as follows: Reelfoot Lake (Obion County), April 26; 4 miles west of Hornbeak, May 3; 8 miles north of Waynesboro, May 14; 6 miles east of Frankewing, in Lincoln County, November 3; 7 miles southwest of Crossville, May 27; Rockwood, April 12, 1884, and Roane County, April 6, 1885 (W. H. Fox); Shady Valley, June 10; 4 miles southeast of Cosby, Cocke County, at 2,700 feet in the Great Smoky Mountains, June 30; Big Frog Mountain, 8 miles southwest of Copperhill, July 10 and 12. After careful comparison of this excellent series all are identified as of the typical race *pileatus*. The wing in males ranges from 216.5 to 229 mm, except for one from Crossville that measures 236.6; in females from 213 to 225.7 mm. The large individual from Crossville is within the minimum range for *C. p. abieticola* and is a strong, robust bird. Though it stands out rather sharply from the others and appears somewhat intermediate, it is not sufficiently large in my opinion to call it the northern subspecies. It will be noted that birds from the mountains near the eastern border agree in size with *pileatus*, a male from Shady Valley (2,900 feet) having the wing 222.5 mm and a female from near Cosby (2,700 feet) in the Great Smoky Mountains measuring 223.5 mm.

The pileated woodpecker was especially common in Lake and Obion Counties in the vicinity of Reelfoot Lake. One was seen near Hickory

[12] *Colaptes auratus borealis* Ridgway, Proc. Biol. Soc. Washington, vol. 24, Feb. 24, 1911, p. 31 (Nulato, lower Yukon River, Alaska).

Withe on April 10, but residents in Fayette and Shelby Counties considered that these woodpeckers were becoming scarce in that area. They were common on Big Frog Mountain. Young just from the nest were found near Waynesboro on May 15, and grown young were recorded on Big Frog Mountain July 10 and 13, and at 2,900 feet on Beans Mountain 2 miles northeast of Parksville on July 14.

CENTURUS CAROLINUS (Linnaeus): Red-bellied Woodpecker

This woodpecker was common in the area adjacent to the Mississippi River, especially in the general region of Reelfoot Lake, while it was less numerous but in fair numbers through the south-central section visited. Records are as follows: Frayser, April 8; Hickory Withe, April 9; Reelfoot Lake, April 26 and 27; near Phillippy, Lake County, October 7, 9, and 12; Cumberland River, 2 miles west of Indian Mound, Stewart County, October 27 and 29; 8 miles north of Waynesboro, November 13; western Lincoln County, 6 miles east of Frankewing, November 9; Rockwood, March 4, 1885 (W. H. Fox).

Measurements of this series are as follows: Males (6 specimens), wing 123.5–129.7, tail 74.5–79.5, culmen from base 28.9–31.9, tarsus 22.3–24.2 mm. Females (8 specimens), wing 124.7–130, tail 73.6–80.5, culmen from base 26–29.5, tarsus 21–22.9 mm.

MELANERPES ERYTHROCEPHALUS ERYTHROCEPHALUS (Linnaeus): Eastern Red-headed Woodpecker

A female taken 3 miles west of Hickory Withe on April 15 has about half of the brown head feathers of the immature dress replaced by red. An adult male was collected at Bartlett, Shelby County, on April 13. Other birds secured in the breeding season were taken as follows: Troy and Hornbeak, Obion County, May 4; 8 miles north of Waynesboro, May 13 and 14; 5 miles east of Crossville, May 28 and 29; and Shady Valley, June 5.

In fall, red-heads were common in the vicinity of Reelfoot Lake. An immature male with red feathers beginning to appear on forehead and auricular and malar regions was secured 3 miles south of Samburg, with an adult female, on October 11. Two were seen and one was taken 2 miles west of Indian Mound on the Cumberland River in Stewart County on October 29.

Measurements of this series are as follows: Males (9 specimens), wing 130–137.7, tail 75–78.5, culmen from base 25.8–27.8, tarsus 23–24. Females (4 specimens), wing 128–134.5, tail 71–75.5, culmen from base 24–26, tarsus 22.2–23.1.

I have given a brief statement of my views on the status of the eastern and western forms in an earlier paper on birds from West Virginia.[14]

SPHYRAPICUS VARIUS VARIUS (Linnaeus): Yellow-bellied Sapsucker

This common winter visitor throughout the State from fall to spring was recorded as follows: Frayser, 4 miles east of Memphis, April 8; Hickory Withe, April 9 and 10; 2 miles east of Phillippy, Obion County, October 9 and 12; 4 miles south of Samburg, October 13; Indian Mound, Stewart County, October 27; 7 miles north of Dover, October 30; 10 miles east of Pulaski, November 2; 6 miles east of Frankewing, Lincoln County, November 4; Lookout Mountain, April 5, 1882 (W. H. Fox); Rockwood, April 3, 1885 (W. H. Fox); Clinch Mountains, 6 miles southwest of Bean Station, September 29.

In the breeding season it was seen on June 4 at 3,800 feet elevation in the Holston Mountains, above Shady Valley.

Two years ago, in examining yellow-bellied sapsuckers collected in West Virginia, I noted an apparent difference in size between breeding birds from the mountains and individuals supposed to be migrant from the north, but on looking up further material for comparison I learned that this same problem was under study by Dr. H. C. Oberholser, so I did nothing at that time with regard to it. Since then Oberholser [15] has published on the matter, recognizing a northern and a southern race, using the subspecific name *varius* for the southern bird and *atrothorax* of Lesson for the northern one.

In study of the present collection from Tennessee I have now examined this question carefully, with results that are of interest. The following statements are based on the study of approximately 60 birds of both sexes taken when they were on their breeding grounds. Comparisons are made between the series from the southern area of the breeding range of the species in the Appalachian Mountain System and the northern region as represented by skins from Canada. Following are comparative measurements of the wing (the average being given in parentheses). The dimensions of tail, culmen, and tarsus are omitted as they show nothing of significance.

MALES

North Carolina, Virginia, West Virginia (5 specimens)	117.5–122.0 (119.3)
Maryland (2 specimens)	118.7–122.5 (120.6)
Pennsylvania (6 specimens)	119.0–124.9 (122.7)
Northern Ontario, Alberta, Athabaska, Mackenzie (15 specimens)	121.1–126.2 (124.2)

[14] Proc. U. S. Nat. Mus., vol. 84, 1937, p. 411.

[15] Dept. Cons. State of Louisiana Bull. 28, 1938, pp. 372–374.

FEMALES

North Carolina, Virginia, West Virginia (10 specimens)	117.7–124.7 (121.4)
Maryland (3 specimens)	121.5–127.3 (124.3)
Pennsylvania (3 specimens)	119.2–123.0 (121.0)
Nova Scotia, Alberta, Athabaska, Mackenzie (15 specimens)	120.8–128.7 (125.0)

It appears from this tabulation that there is an average difference of between 3 and 4 percent in length of wing between the northern and southern groups. A study of the specimens, however, reveals that the ends of the primaries are more worn in the birds available from the south than in those from the far north. It is evident that this wear has shortened the wings of southern birds by at least a millimeter and probably more, so that the actual difference in size is less than the average figures indicate, in other words less than 3 percent.

There is an extensive area from Pennsylvania across to North Dakota and from there north to Canada where birds vary between the two extremes. A fair number of southern birds are large, and many of the northern ones are small, so that the actual differences between the two groups are quite indefinite. Identification of fully half of the individuals off their breeding grounds, if two races are recognized, therefore necessarily must be purely arbitrary. In view of this I do not feel that two geographic races can be accepted. In my opinion the slight differences that are shown between northern and southern birds are to be considered merely an indication of the well-known fact that northern birds among the woodpeckers are larger than southern ones. In the case of the yellow-bellied sapsucker the difference has not progressed far enough to warrant systematic recognition.

In this connection, notes that I have made recently on Lesson's *Picus atrothorax*,[16] which Dr. Oberholser has used for his northern race of the yellow-bellied sapsucker, may be of interest. The original description of Lesson in full is as follows:

62. Pic a plastron noir; *Picus atrothorax*. Tête brune, pictoée en avant de rouge; gorge blanche; plastron noir sur le thorax; parties inférieures blanches, tachetées de brun.

Pucheran [17] wrote that he had not been able to identify this species of Lesson's, but two years later [18] he said that Malherbe had found in the collection at Paris a bird from Newfoundland obtained in exchange from Canivet in 1828 that he, Pucheran, considered to be the female of *Picus atrothorax* and that he identified as *Picus varius*, in other words as the yellow-bellied sapsucker. Pucheran noted that the crown in this specimen was black instead of brown. It is this specimen that Berlioz has marked as the probable type of *atrothorax*.

[16] *Picus atrothorax* Lesson, Traité d'ornithologie, 1831, p. 229 (no locality given).
[17] Rev. Mag. Zool., 1853, p. 162.
[18] Rev. Mag. Zool., 1855, p. 22.

When at the Paris Museum recently I took occasion to examine this bird and checked the discrepancy in head color noted by Pucheran. I went through the old catalog of the bird collection to find that in addition to this bird there had been another in the museum prior to 1831, when Lesson named *atrothorax*, an individual cataloged as No. 2170, marked as taken at Philadelphia by Lesueur in 1824. This second specimen was located after some search, and was found to be an immature individual of the eastern *Sphyrapicus varius* with the crown brown, spotted with red, but without the black crescent on the breast.

The first specimen, No. 2168, female, from Newfoundland, is a mounted bird in fair condition, though a little faded from exposure to light, and has the following measurements: Wing 122.5, tail 72.8, culmen from base 22.5, tarsus 21.2 mm. To repeat, this bird has the crown deep black, with three tiny dots of red on the left side of the center, and a prominent black crescent on the breast. The second specimen, No. 2170, an immature bird with sex not marked, from Philadelphia, is also a mounted bird, complete and in fair condition, except that some of the rectrices are loose. The crown is brown with numerous spots of red, and there is no black on the breast. It measures as follows: Wing 123.7, tail 70.8, culmen from base 23.0, tarsus 19.2 mm.

It appears that Lesson must have drawn his description from these two individuals and that the type material is composite.

DRYOBATES VILLOSUS VILLOSUS (Linnaeus): Eastern Hairy Woodpecker

The State of Tennessee includes an extensive area of intergradation between the northern and southern forms of the hairy woodpecker, races that differ mainly in smaller size coupled with some restriction of the white markings on the dorsal surface in the southern subspecies. Transition in size from north to south is gradual, without sudden break. Specimens from the vicinity of Reelfoot Lake are definitely intermediate between the two races under consideration (wing in 2 males 117 and 119 mm, in 2 females 115 and 115.8 mm), but they seem slightly nearer the northern group. The specimens seen include skins from Reelfoot Lake, April 28 and May 7; 3 miles south of Samburg, October 11; 2 miles south of Ridgley, October 15; and 7 miles northeast of Tiptonville, October 22. Their identification as *villosus* is tentative in view of the fact that the southern race has been recorded from the Mississippi bottoms in southern Indiana and southern Illinois. In the Biological Survey collection there is a male with the wing much worn, taken at Lexington by A. H. Howell on July 9, 1910, with a measurement of 115.5, that seems also intermediate but is in such a state of plumage that it is difficult to place.

A pair of birds from western Lincoln County 6 miles east of Frankewing (male, wing 119.8, female 116.8), taken November 5 and 6, in size and in the considerable extent of white on the back are of the northern type, as are two males (wing 120.3 and 119.3 mm) secured by W. H. Fox at Rockwood on March 9 and 28, 1885. A male collected at 1,900 feet elevation in the Clinch Mountains 3 miles northwest of Rutledge on October 1 (in molt so that the wing apparrently is not quite grown) also belongs here, with a wing measurement of 118.5 mm. Specimens from the higher elevations in the eastern mountains are definitely of the northern race. A male (wing 120.1) was taken at Shady Valley June 7. Birds secured at elevations of 5,000 feet or more on Roan Mountain on September 20 to 23 are in molt, so that the wing is not grown but affords sufficiently large measurements to indicate that they are true *villosus*. In the Great Smoky Mountains a male (wing 118) was taken at 6,300 feet on Old Black Mountain on June 21, one (wing 122) at 2,700 feet 4 miles southeast of Cosby on June 23, and one (wing 118) at 6,500 feet on Mount Guyot on June 26.

Birds of the year, fully grown, were taken at Reelfoot Lake on May 7, at 3,000 feet elevation 7 miles north of Carter on June 7, near Cosby on June 23, at 5,700 feet elevation on Inadu Knob on June 24, and at 6,000 feet elevation on Old Black Mountain on June 24, the last three being in the Great Smoky Mountains. One of the juvenile females has the center of the crown definitely spotted with white and with elongated marks of red; another has four or five of the elongated red markings only; and in a third markings are absent.

DRYOBATES VILLOSUS AUDUBONI (Swainson): Southern Hairy Woodpecker

The southern race of the hairy woodpecker has a range uncertainly delimited at present in the southern section of the State. A female taken at Bartlett on April 19 has a wing measurement of 112.8 mm; a juvenile female not fully grown taken on May 14, 8 miles north of Waynesboro, is identified tentatively as *auduboni*. Adult material is necessary to check this allocation. A pair secured on May 27 on Birds Creek 7 miles southwest of Crossville measure as follows: Wing, in male 111.0, in female 112 mm. The three adults just mentioned have the wings considerably worn, but after careful examination it does not appear to me that enough of the end of the wing is gone to permit their being *villosus*. I have examined with particular care the two from Crossville, since March birds from Rockwood a short distance east are the northern bird. A juvenile female with unmarked crown was taken also with the adults from near Crossville. The southern bird is also the form of Big Frog Mountain in Polk County, as indicated by two specimens secured 8 miles southwest of

Copperhill, a male taken at 2,100 feet on July 15, with the wing 112 mm, and a female secured at 1,800 feet on July 12, with the wing 114.5 mm. A juvenile male was collected here on July 15. The adults are much worn, but the same statement holds with them as that made for the Crossville specimens.

It is strange that the birds from Frankewing have the size and color of true *villosus*, in view of the fact that the bird from Crossville has the smaller size of *audubonì*. As the Frankewing specimens were taken in November, it is barely possible that they had moved into that area from the north, though it seems more probable that they were resident. Considerable further collecting will be necessary to work out the status and distribution of the southern form, particularly in the area adjacent to the Mississippi River, and in the southeast.

DRYOBATES PUBESCENS PUBESCENS (Linnaeus): Southern Downy Woodpecker

As in the case of the hairy woodpecker, the downy woodpecker of Tennessee covers a considerable area where there is definite intergradation between the northern and the southern forms. The southern subspecies, *pubescens*, has the wing in both males and females ranging from 86 to 91 mm, while in the northern bird, *medianus*, the same dimension varies from 91 to 97 mm. It is usually supposed that the southern bird is duller white below, a character that is entirely unreliable, as any recent burn will smudge the breasts of all woodpeckers from the charcoal and ash on the bark of the trees and shrubs over which they clamber.

Birds that I have identified as typical *pubescens* come from the southern sections of Tennessee. A male collected at Hickory Withe, Fayette County, on April 10 has the wing 88 mm, and a female from the same point taken on April 9 measures 90.5 mm. In the western edge of Lincoln County, 6 miles east of the post office of Frankewing, a male measuring 88.3 mm was taken on November 3, and a female with the wing 90.5 mm on November 6. At this point there was a mixture, as larger birds measuring 93.8 and 94 mm were obtained at the same time. These are considered *medianus* and may be migrant from some mountain or northern area nearby. A male from Birds Creek, 7 miles southwest of Crossville, May 24, has the wing 89.6 mm. Mixing is evident at Rockwood also, in material collected by W. H. Fox, as two males taken on April 11, 1884, and April 15, 1885, measure 91 mm, and a female secured April 7, 1884, is 91.1 mm. Another female, taken on March 13, 1885, is 95.5 mm and represents *medianus*, and again may have come from a nearby mountain. A male taken at 2,100 feet elevation on Big Frog Mountain, 8 miles southwest of Copperhill, July 9, measures 89 mm.

DRYOBATES PUBESCENS MEDIANUS (Swainson): Northern Downy Woodpecker

In a considerable area in the northwestern part of the State intermediate specimens of the downy woodpecker occur that are barely within the size range of the northern form. Specimens of this type are represented from the region about Reelfoot Lake, as indicated in the following list where the wing measurements are enclosed in parentheses following the locality and date of the birds to which they pertain: Tiptonville, October 19 (2 males, 90 and 93.9; 2 females, 91 and 92); Samburg, October 14 (91.9); and Reelfoot Lake, April 29 (90.5). Specimens in this same category from other localities include a male from the Cumberland River, in Stewart County, 2 miles west of Indian Mound, October 27 (wing 91.5), a female from 7 miles north of Dover in the same county, October 30 (92.4), and a female from much farther south, in Wayne County, 9 miles north of Waynesboro, May 11 (wing 92 mm). Further material from this area is required to establish more certainly the form found there. For the present it is considered to be *medianus*.

As indicated in the account of *D. p. pubescens*, there seems to be some mixing in the downy-woodpecker population at a few points, due perhaps to migratory movement or to specimens taken at different altitudes. This is true in western Lincoln County 6 miles east of Frankewing, where males taken November 5 and 6 measure 93.8 and 94 mm, though others have the size of *pubescens*, and at Rockwood where one female secured by W. H. Fox, March 13, 1885, measures 95.5 mm, though others are *pubescens*.

In the mountain section in the northeast, from the Great Smoky Mountains northward, all the birds examined are definitely large and can be referred without hesitation to true *medianus*. These include the following (with the wing measurements again given in parentheses): Cross Mountain, near the line of Anderson and Campbell Counties, August 15, 1908, taken by A. H. Howell (male 95.7, female 95); Bean Station, Grainger County, October 1 (male 95); 3,800 feet elevation in the Holston Mountains, near Shady Valley, June 3 and 4 (male 95.5, female 92.7 and 93.8); 5,000 to 6,200 feet elevation on Roan Mountain, September 13 to 22 (male 94.2, females 93.9 and 96.1); 6,300 feet elevation on Old Black Mountain, Great Smoky Mountains, June 25 (male, 95.5); Inadu Knob, near Cosby, June 21 (female 92.1).

DRYOBATES BOREALIS (Vieillot): Red-cockaded Woodpecker

Perrygo recorded one of these birds near the Cumberland River, 7 miles north of Dover on October 30 but did not collect it. There are three in the National Museum taken by W. H. Fox at Rockwood, a pair on April 11, 1884, and a male on April 22, 1885.

The considerable length of the wing tip in this species is equaled among our other woodpeckers only by the sapsuckers of the genus *Sphyrapicus*, and indicates a considerable divergence from the condition found in the related hairy and downy woodpeckers.

Family TYRANNIDAE

TYRANNUS TYRANNUS TYRANNUS (Linnaeus): Eastern Kingbird

The kingbird was recorded as follows: Hickory Withe, April 10; Ellendale, April 17 (specimen); Reelfoot Lake, April 27 (specimen); Troy, May 1; Hornbeak, May 3; Samburg, May 5 and 6; Waynesboro, May 10 to 18 (specimen); Pikeville, May 21 and 29; Crossville, May 27 and 29; Rockwood, April 17, 1885 (specimen by W. H. Fox); Bearden, June 1; and Cosby, July 5. The western race of this species described by Oberholser [19] is marked mainly by slightly grayer dorsal coloration, the alleged difference of larger size holding only for part of the individuals examined. The white band on the tip of the tail averages slightly wider in the western race but is subject to considerable abrasion, so that in numerous specimens from the west no difference is to be noted. Zimmer [20] states that he has been hesitant about recognizing two races in this species, but such action to me seems valid, though as indicated the difference between the two is slight.

MYIARCHUS CRINITUS BOREUS Bangs: Northern Crested Flycatcher

On April 27 a female crested flycatcher was taken at Reelfoot Lake, and two others were seen. Two were seen near Hornbeak on May 1, and others about the lake on May 7. They were fairly common at Waynesboro from May 10 to 14 and near Pikeville on May 31. W. H. Fox collected one at Rockwood on April 15, 1885. One was taken in the Holston Mountains above Shady Valley on June 4. One was seen on June 24 at 3,800 feet on Snake Den Mountain in the Great Smoky Mountains, and two at 3,900 feet on Big Frog Mountain, July 10.

Eight specimens from Tennessee examined all agree in color and in size of bill with the northern race.

SAYORNIS PHOEBE (Latham): Eastern Phoebe

Specimens were seen or collected as follows: Hickory Withe, Fayette County, April 12; Samburg, May 2; Phillippy, Lake County,

[19] *Tyrannus tyrannus hespericola* Oberholser, Sci. Publ. Cleveland Mus. Nat. Hist., vol. 4, Sept. 19, 1932, p. 3 (mouth of Twenty Mile Creek, Warner Valley, 9 miles south of Adel, Oreg.).

[20] Amer. Mus. Nov., No. 962, Nov. 18, 1937, pp. 12–13.

October 23; Waynesboro, May 12 and 17; Lookout Mountain, March 21, 1882 (specimen by W. H. Fox); Birds Creek, 7 miles southwest of Crossville, May 24 and 26 (the latter a juvenile bird just from the nest); Rockwood, April 12, 1884 (specimen by W. H. Fox); 2,000 feet elevation, Clinch Mountains, 6 miles southwest of Bean Station, September 29; 2,800 feet elevation in the Holston Mountains, near Shady Valley, June 3; 2,700 feet elevation, 4 miles southeast of Cosby, June 23 and July 2.

EMPIDONAX VIRESCENS (Vieillot): Acadian Flycatcher

Specimens of the Acadian flycatcher were obtained as follows: 8 to 10 miles north of Waynesboro, May 10, 12, and 19; near Shady Valley, at 3,600 feet in the Iron Mountains, June 6, and at 2,900 feet in the Holston Mountains, June 12; at 3,000 feet 7 miles north of Carter, June 7; and at 2,700 feet, 4 miles southeast of Cosby in the Great Smoky Mountains, June 30 and July 1 and 2.

MYIOCHANES VIRENS (Linnaeus): Eastern Wood Pewee

Specimens were obtained as follows: Eads, Shelby County, April 20; Reelfoot Lake, April 27; near Hornbeak, May 3; 8 to 9 miles north of Waynesboro, May 11 and 14; 7 miles southwest of Crossville, May 25; Clinch Mountains near Bean Station, September 27 and 28; Shady Valley, June 10; Roan Mountain, at 5,000 feet elevation, September 25.

Van Rossem [21] recently has brought up again the question of the relationship of the eastern and western groups of wood pewees by listing the western wood pewee as *Myiochanes virens richardsonii*. That the two wood pewees are so closely similar in color and form as to be distinguished at times with difficulty in museum skins is easily apparent, but that this is external resemblance without closer relationship than that of distinct species seems evident to me from knowledge of the two in life. After a familiarity of many years I am convinced that they are distinct, as indicated by entirely different voice. In this regard it is only necessary to consider the close resemblance of females of the blue-winged and cinnamon teals as a related case. With the teals the males are entirely different, so that there is no confusion. With the wood pewees the sexes are alike, so that the two are separated with difficulty.

NUTTALLORNIS BOREALIS (Swainson): Olive-sided Flycatcher

An adult male was collected at 5,000 feet elevation on Cosby Knob in the Great Smoky Mountains on June 19. Another was seen at

[21] Birds of El Salvador. Field Mus. Nat. Hist., zool. ser., vol. 23, 1938, p. 371.

5,700 feet on Inadu Knob on June 23, and one was recorded at 6,100 feet on Roan Mountain, September 12.

In the fourth edition of the A. O. U. Check-list (1931, p. 211) the olive-sided flycatcher is listed as *Nuttallornis mesoleucus* (Lichtenstein) following Hellmayr,[22] who based this on *Muscicapa mesoleuca* Lichtenstein.[23] More recently, however, Van Rossem [24] has located Lichtenstein's type in the Berlin Museum to find that it is a species of South American flycatcher. This circumstance allows return again to the familiar name *borealis* as the specific term for this attractive flycatcher.

The bird from Cosby Knob, an adult male in good plumage, is very small, measuring as follows: Wing 100.8, tail 65.9, culmen from base 17.5, tarsus 15.5 mm.

After examination of a large series of specimens, the contention of some that there are eastern and western forms of this flycatcher in my opinion is not upheld. It is true that the specimens with the longest wings come from the west, and those with the shortest wing measurement from the east, so that by averages a slight difference between series from the two areas is evident. The overlap in size in skins from the two areas is such, however, that the majority of individuals might be classed in either group, only a few specimens among the extremes of large and small being susceptible of separation. In these circumstances I do not consider recognition of two races warranted. The statement is made only after examination of a large number of skins.

Family ALAUDIDAE

OTOCORIS ALPESTRIS PRATICOLA Henshaw: Prairie Horned Lark

One was seen 5 miles west of Lawrenceburg, May 16.

Family HIRUNDINIDAE

IRIDOPROCNE BICOLOR (Vieillot): Tree Swallow

A male was taken at Rockwood, April 14, 1885, by W. H. Fox. Perrygo recorded this species near Eads on April 14 and found it common at the end of April in Obion and Lake Counties, recording two flocks near Tiptonville on May 1. In fall he observed it in the vicinity of Reelfoot Lake from October 5 to 21.

RIPARIA RIPARIA RIPARIA (Linnaeus): Bank Swallow

Recorded at Eads on April 16, 19, and 20 and at Reelfoot Lake on April 24.

[22] Field Mus. Nat. Hist., zool. ser., vol. 13, pt. 5, 1927, p. 189.
[23] Preis-Verzeichniss Vögel Mexico gesammelt, etc., 1830, p. 2.
[24] Trans. San Diego Soc. Nat. Hist., vol. 7, 1934, pp. 350–352.

Oberholser [25] has considered the bank swallow of North America when compared with that of Europe as separable under the name *maximiliani* of Stejneger,[26] stating that our bird is darker above in addition to being slightly smaller. After careful comparison of a good series in the American Museum of Natural History and the United States National Museum from England, Sweden, Germany, Austria, and Russia with a comparable set from Ontario, Quebec, New York, New Jersey, and Connecticut, I am unable to establish any line of demarcation between them. There is considerable variation individually in the shade of brown above, but light and dark specimens occur on both continents. There is also considerable range in size in this race, and there appears no difference in dimensions between Old World and New World birds. My findings, therefore, agree with those of European ornithologists who have considered this matter.

STELGIDOPTERYX RUFICOLLIS SERRIPENNIS (Audubon): Rough-winged Swallow

The specimens secured include two immature birds taken on October 6 at Reelfoot Lake, 6 miles northeast of Tiptonville, where hundreds were recorded, and a male from 3 miles north of Pikeville, on May 28. At Rockwood W. H. Fox shot a female on April 16, 1884, and a male on April 4, 1885. I saw one near Carter on June 7, 1937.

While the South American representatives of our rough-winged swallows are quite distinct in yellowish abdomen and reddish-brown throat, through Central America intergradation is complete to such an extent that I have taken specimens in the highlands of Guatemala that at first glance I thought must surely be migrants from the United States. All the forms of this widespread group are therefore to be treated as geographic races of one species.

After detailed study of the series of specimens in the U. S. National Museum, I have been unable to detect any differences in birds from the west, which have recently been described by Oberholser as a distinct subspecies *aphractus*.[27] In color and size specimens from the area in which *aphractus* is supposed to range to me appear identical with birds from the east. The race named by Griscom from Sonora as *psammochrous* [28] is, on the other hand, distinct in being paler above than *serripennis* and in averaging somewhat lighter on the breast, though this last difference is slight and in-

[25] Dept. Cons. State of Louisiana Bull. 28, 1938, p. 407.

[26] *Clivicola riparia maximiliani* Stejneger, U. S. Nat. Mus. Bull. 29, 1885, p. 378, footnote (Ipswich, Mass.).

[27] *Stelgidopteryx ruficollis aphractus* Oberholser, Sci. Publ. Cleveland Mus. Nat. Hist., vol. 4, Sept. 19, 1932, p. 5 (Twenty-mile Creek, 9 miles south of Adel, Oreg.).

[28] *Stelgidopteryx ruficollis psammochrous* Griscom, Proc. New England Zoöl. Club, vol. 11, Dec. 14, 1929, p. 72 (Oposura, Sonora, Mexico).

definite. As Oberholser states in his description of a supposed western race just cited, *psammochrous* enters the United States along the southwestern boundary, there being specimens in the U. S. National Museum as follows: Texas, near Laredo; Arizona, San Bernardino Ranch, Santa Cruz River west of the Patagonia Mountains, Adonde, Fort Verde, and Fort Whipple near Prescott; California, Jacumba and San Diego.

Van Rossem [29] at one time considered that the characters assigned to *psammochrous* were due to fading in specimens long in museum collections, but after further work he informs me that he has found that this conclusion was wrong. In my own comparisons I have had available birds of equivalent condition as regards date of collection, and as the differences are apparent in these I must conclude that *psammochrous* is valid.

HIRUNDO RUSTICA ERYTHROGASTER Boddaert [30]: Barn Swallow

The barn swallow was seen as follows: Common near Reelfoot Lake at the end of April, seen October 8 and 16; Samburg, May 6, several; Waynesboro, May 10, four; Shady Valley, June 1 to 11, seen daily, and a pair nesting in a barn at the post office.

PROGNE SUBIS SUBIS (Linnaeus): Purple Martin

Seen as follows: Hickory Withe, April 9; Ellendale, April 16; Eads, April 23; Tiptonville, May 1; Union City, May 2; Samburg and Hornbeak, May 6; near Beech Creek, 12 miles northwest of Waynesboro, May 13; Crossville, May 26; Shady Valley, June 4, one.

Family CORVIDAE

CYANOCITTA CRISTATA CRISTATA (Linnaeus): Northern Blue Jay

As a winter visitor this form, marked by larger size, lighter, bluer dorsal coloration, and more extensive white on the tertials and secondaries, should be found throughout the State. There are only two specimens in the present collection that are placed under this race and those with some reservations. A male taken near Phillippy on October 7 (with the wing 129.3) is small but has the color and wing marking of the northern form. While intermediate it is believed to be near *cristata*. A male from the Clinch Mountains 6 miles southwest of Bean Station taken on September 30 measures 131.7. It is of the proper shade of blue above but has the white margins on the wing feathers as in *florincola*. It also appears intermediate. While these are listed here as *cristata*, it will be noted that neither is entirely

[29] Trans. San Diego Soc. Nat. Hist., vol. 6, Apr. 30, 1931, p. 268.
[30] See Wetmore, Proc. U. S. Nat. Mus., vol. 84, 1937, pp. 413–414.

typical of that form. Collections made later in fall and in winter should include migrants from the north.

CYANOCITTA CRISTATA FLORINCOLA Coues: Florida Blue Jay

From examination of an excellent series of jays taken throughout the State it appears that the breeding bird from the area represented is to be identified as the southern form. The identification is made on the basis of duller, more purplish dorsal coloration, less extent of white tipping on tertials and secondaries, and smaller size particularly as indicated in length of wing. It is true that some birds from the eastern mountain area are larger than the average of *florincola*, and so come within the lower size range of *cristata*, but in color these larger individuals resemble the others of smaller size.

The birds just mentioned from the eastern mountains are puzzling and show definite intermediate characters. Two males taken in Shady Valley on June 8 have wing measurements of 125.5 and 135.4 mm, and a female collected on June 2 measures 131.6 mm. A male taken at 4,500 feet on Snake Den Mountain in the Great Smokies on June 24 has the wing 133.8. On the basis of size three of these four specimens could be called true *cristata*, but in dorsal coloration they are distinctly darker, more purplish, and have the white wing markings restricted. They are identified at present as *florincola*. A male from 5,000 feet elevation on Roan Mountain taken on September 23 is even more intermediate. The wing measures 129.5, and the white on the tertials is reduced as in *florincola*, but the blue above is brighter and less purplish. It is possible that when more skins are available it may prove better to place the jays of the mountain region with *cristata*, though the material now available points to the allocation made here.

Other breeding birds are all definitely of the *florincola* type of coloration, and only a few approach *cristata* in size. All are small enough to come within the range of measurement assigned to *florincola*. Following is a list of specimens, with the wing measurements indicated in parentheses: Hickory Withe, April 12 and 13, 3 males (130.1, 131.7, 127); Reelfoot Lake, April 26 and 27, 2 males (127.3, 128.6); Hornbeak, May 1, male (127.7); 8 miles north of Waynesboro, May 13 and 15, 2 males (130, 131.2); Melvine, Bledsoe County, May 21 (133.5); Birds Creek, 7 miles southwest of Crossville, May 27, 2 males (126, 132.2).

Fall specimens allocated here include two from Samburg, a male taken on October 11 (124) and a female October 13 (124); Cumberland River 2 miles west of Indian Mound, October 27, female (123); and Cumberland River, 7 miles north of Dover, October 30, female (123.5).

Blue jays were found to be commoner than anticipated through the mountains of the eastern section of the State. In addition to the specimens seen they were recorded as follows: Clinch Mountains near Bean Station, September 27 to 30, several; Holston Mountains above Shady Valley, June 2 to 16, common; Roan Mountain, September 11, one, and September 23, five; Great Smoky Mountains, Low Gap near Cosby, June 19, one, Cosby Knob at 5,000 feet, June 19, one, Snake Den Mountain at 5,000 feet, July 2; Big Frog Mountain, July 13, one.

CORVUS CORAX PRINCIPALIS Ridgway: Northern Raven

The raven was recorded in the Great Smoky Mountains near Cosby on June 19, when two were seen, and at 6,600 feet on Mount Guyot on June 27, when four were observed. At 3,000 feet elevation on Big Frog Mountain one was heard on July 13 and another on the following day, but because of the trees the birds were not actually seen. During work on Roan Mountain three were seen on September 11, five on September 12, and single birds were observed regularly. They passed in the morning flying toward the north and returned at dusk traveling toward the southeast into North Carolina.

CORVUS BRACHYRHYNCHOS BRACHYRHYNCHOS Brehm: Eastern Crow

The crow population through the greater part of Tennessee is decidedly intermediate between the rather poorly differentiated northern and southern subspecies. In general the birds from the northern part of the State west of the high mountain area to the Mississippi seem to agree best, on the material at hand, with true *brachyrhynchos* when the two characters of length of wing and size of bill are considered. Several are intermediate, and a larger series of birds may cause some change in this conclusion. In a pair taken at Reelfoot Lake near Tiptonville, the male is distinctly of the *brachyrhynchos* type with the wing 323 and the culmen from base 52 mm. The female is somewhat small, with the wing 300 and the culmen from base 49.0. These two birds apparently were mated with grown young out of the nest. They are the only specimens taken in the breeding season that are identified as *brachyrhynchos*. In three males secured near Phillippy in fall, a male shot on October 7 is very large (wing 329, culmen from base 52 mm). Two others taken on October 7 and 12 measure as follows: Wing 305 and 300, culmen from base 51.7 and 50.8 mm. The wings in these two are decidedly worn, as the primaries have not yet been molted. This

accounts in part for the small wing measurement, and because of this condition and the large bill these are called *brachyrhynchos*. In two taken on the Cumberland River two miles west of Indian Mound on October 27, a male has the wing not yet fully grown, while the culmen measures 50 mm. A female has the wing 305 and the culmen from base 48.5. While intermediate these two are called *brachyrhynchos*.

The recent proposal of Dr. Wilhelm Meise [31] and Dr. C. E. Hellmayr [32] to give the American crow status as a geographic race of *Corvus corone*, the carrion crow of Europe, is one that does not to me seem proper. After a field experience gained through three journeys in western Europe, I am convinced that the resemblance between these two birds is of a generic nature and that specifically they are distinct. Their resemblance is found principally in that the two are generally similar in form, are black in plumage, are alike in size, and have more or less the same habits and ecological status. In the field, the voice of the carrion crow is more like that of a raven, quite distinct from that of our crow, so different in fact that in May 1938 in Switzerland I did not recognize the call of a carrion crow when heard for the first time in four years as that of a crow until it had been repeated several times. In flight the wing action of the carrion crow also is different, the wings having a wider sweep above and below the longitudinal axis of the body. Ordinarily, too, in the European species the tips of the primaries in flight are more widely separated, the wing appearance being that of a raven. In the hand, the outer primaries are actually narrower than in the American crow. In view of all this and of the geographic separation of the two, it appears to me that they should be considered specifically distinct.

CORVUS BRACHYRHYNCHOS PAULUS Howell: Southern Crow

A male secured near Hickory Withe on April 21 identified as *paulus* is distinctly intermediate toward the northern form, with the wing 305 and the culmen from base 50.2 mm. While this specimen is here called *paulus*, further material may demonstrate that the breeding crows throughout extreme western Tennessee are best called *brachyrhynchos*. A female from 5 miles north of Waynesboro on Green River, with the wing 300 and the culmen from base 44.5 mm, has the small bill of *paulus*. A male from 7 miles southwest of Crossville on Birds Creek is intermediate, with the wing 309 and the culmen from base 50.5 mm. It is identified as *paulus* with some reservation.

[31] Journ. für Orn., 1928, p. 8.
[32] Field Mus. Nat. Hist., zool. ser., vol. 13, pt. 7, 1934, p. 3.

Breeding specimens from 2,900 feet elevation at Shady Valley are definitely of the *paulus* type, a male shot June 5 having the wing 290 and the culmen from base 48.8 mm, while a female taken on June 7 has the wing 295 and the culmen from base 45.3 mm. These two agree with a breeding bird from White Top Mountain, Va., a short distance away to the northeast. A female collected in Lincoln County, Tenn., 6 miles west of Fayetteville, November 1, measures as follows: Wing 297, culmen from base 46.9. It also is considered *paulus*.

Family PARIDAE

PENTHESTES ATRICAPILLUS PRACTICUS Oberholser: Appalachian Chickadee

In the higher elevations of the Great Smoky Mountains the black-capped chickadee though not common is found in fair numbers. Adult males were taken at 6,300 feet on Old Black Mountain on June 21 and 25, at 6,600 feet on Mount Guyot on June 21, and at 6,100 feet on Inadu Knob on June 24 and 26.

In commenting recently on a series of these chickadees from the mountains of West Virginia,[33] I noted the slightly darker color of those birds compared with specimens from New York, New England, and Ontario. Since then Dr. Oberholser has described these southern mountain birds as *Penthestes atricapillus practicus*.[34] After comparison of the series of these chickadees in the U. S. National Museum, I am prepared to recognize this as a distinct race though its characters are comparatively slight. Specimens in worn breeding dress are most distinct, as the southern birds then are darker gray above. In fall and winter plumage they appear very slightly darker than the similar stage from the north, so that individual specimens can often be separated only with difficulty. This race will include those specimens noted above from West Virginia listed previously as *Penthestes a. atricapillus*.

PENTHESTES CAROLINENSIS CAROLINENSIS (Audubon): Carolina Chickadee

The nominate race of the Carolina chickadee differs from the northern subspecies *extimus* in being darker gray on the back and rump, paler buffy brown on the sides and flanks (especially in fall and winter dress), and in averaging very slightly smaller. It is interesting to find this form spread over eastern and central Ten-

[33] Proc. U. S. Nat. Mus., vol. 84, 1937, p. 416.

[34] *Penthestes atricapillus practicus* Oberholser, Proc. Biol. Soc. Washington, vol. 50, Dec 28, 1937, p. 220 (Mount Guyot, Great Smoky Mountains, N. C.)

nessee even in the lower levels of the eastern mountains. Following are records based on specimens: 9 miles north of Waynesboro, Wayne County, May 16; western Lincoln County, 6 miles east of Frankewing, November 3 and 4; 5 miles east of Crossville, May 28 and 29; Rockwood, March 4 and 13, 1885 (taken by W. H. Fox); Rogersville, May 1885 (taken by J. W. Rogan); 2,000 feet elevation in the Clinch Mountains, 3 miles west of Bean Station, September 30; Holston Mountains and Shady Valley (2,900 feet elevation), June 3, 5, and 6; 2,600 feet elevation 4 miles southeast of Cosby, June 28 (adult and immature fully grown); 1,800 to 3,000 feet elevation on Big Frog Mountain, 8 miles southwest of Copperhill (adult and grown young), July 9, 10, and 11; 2,400 feet elevation on Beans Mountain 2 miles northeast of Parksville (immature), July 13.

Specimens taken in the breeding season agree in dorsal color with a series of *carolinensis* from near Charleston, S. C., the restricted type locality. Fall birds from Bean Station and Frankewing are very faintly darker above than *extimus* but have the flanks and sides paler. Differences in size between *extimus* and *carolinensis* are not of much diagnostic value, as in dimensions the two races are very similar.

The Tennessee specimens average about the same as those from South Carolina, and their color is such as to allow no hesitance in placing them with *carolinensis*. Following are measurements from the series from Tennessee: Males (8 specimens), wing 58.4–64.0 (61.3), tail 50.5–55.2 (52.7), culmen from base 8–9.3 (8.6), tarsus 15–16.5 (15.5); females (9 specimens), wing 56.8–60.7 (58.3), tail 49.1–53 (50.8), culmen from base 7.5–9.3 (8.6), tarsus 14–16 (15) mm.

Birds from South Carolina (Kershaw County, Aiken, and the vicinity of Charleston) measure as follows: Males (8 specimens), wing 57.8–63.8 (61.0), tail 49.2–54.8 [35] (51.6), culmen from base 7.8–9.7 (8.6), tarsus 15.3–17.2 (15.8); females (5 specimens), wing 56.7–58.8 (57.5), tail 47.2–49.6 (48.3), culmen from base 8.1–8.7 (8.5), tarsus 14.8–15.8 (15.2) mm.

Dr. Oberholser recently has named a race of this chickadee from Louisiana,[36] giving as the range the lower Mississippi Valley north to central Alabama and southwestern Kentucky, which includes a part of Tennessee. He states that his new form is "similar to *Penthestes carolinensis impiger* from Florida, but upper parts paler and more grayish. Like *Penthestes carolinensis carolinensis* but decidedly smaller.

[35] Seven specimens.

[36] *Penthestes carolinensis gulliotl* Oberholser, Dept. Cons. State of Louisiana Bull. 28, 1938, p. 425 (Belair, La.).

"*Measurements.*—Adult male: wing, 57–61 (average, 58.9) mm.; tail, 48–54.3 (50.5); exposed culmen, 6.8–7.5 (7.1); tarsus, 16; middle toe without claw, 9.5–11 (9.9). Adult female: wing, 53–59 (56.6); tail, 46.5–52 (48.5); exposed culmen, 6.5–7.5 (7.2); tarsus, 15–16.5 (15.6); middle toe without claw, 9–10 (9.7)."

Without going into the question of the validity of *guilloti* in the southern part of its assigned range, I consider the Carolina chickadees from Tennessee to be identified subspecifically as *carolinensis* and *extimus* according to the data presented under the present and the following headings.

PENTHESTES CAROLINENSIS EXTIMUS Todd and Sutton: Northern Carolina Chickadee

In western Tennessee the northern race of this chickadee extends across the State from north to south as indicated by the following records based on specimens: Hickory Withe, April 10 and 16; Reelfoot Lake, April 29; Samburg, Obion County, October 11; Cumberland River 2 miles west of Indian Mound, October 27; and Cumberland River 7 miles north of Dover, October 30.

These skins are identical in every way with specimens typical of *extimus* from West Virginia and elsewhere in the range of this race. Measurements of the Tennessee series are as follows: Males (6 specimens), wing 59.7–64.3 (62.4), tail 51.5–56.7 (53.9), culmen from base 8.3–9.1 (8.7), tarsus 15.1–16.5 (16.0); females (2 specimens) wing 56.2–59.4 (57.8), tail 51.5, culmen from base 8–8.5 (8.2), tarsus 15–16.2 (15.6) mm.

BAEOLOPHUS BICOLOR (Linnaeus): Tufted Titmouse

This species is common throughout Tennessee except in the higher elevations of the mountains along the eastern border. Records in the collection are as follows: Hickory Withe, April 9 and 10; Reelfoot Lake, April 28; Waynesboro, May 11 and 12; Pulaski, November 1 and 2; Chattanooga, March 13, 1882 (W. H. Fox); Lookout Mountain, March 24, 1882 (W. H. Fox); Crossville, May 26; Rockwood, April 8 and 19, 1884, and March 24, 1885 (W. H. Fox); 2,000 feet elevation in the Clinch Mountains, 3 miles west of Bean Station, September 30; 2,900 to 3,300 feet in the Holston Mountains, and Shady Valley, June 2, 5, and 12; 5,000 feet elevation on Roan Mountain, September 23; 1,800 feet elevation on Big Frog Mountain, 8 miles southwest of Copperhill, July 12.

In examining this Tennessee material I have made careful comparison again of the series in the National Museum to find that in fall and winter birds from South Carolina (Kershaw County and Charleston and vicinity) the brownish wash on the back is slightly duller

than in birds from the north, while in the breeding season the back is very slightly darker gray. Specimens from Florida are less definitely marked. In skins from West Virginia and Kentucky northward the dorsal wash in fall is very slightly brighter brown, and the gray of the back in summer barely perceptibly paler. The differences appear to me too slight to be worth separation.

Family SITTIDAE

SITTA CAROLINENSIS CAROLINENSIS Latham: White-breasted Nuthatch

While the white-breasted nuthatches that I have seen from eastern Tennessee are not wholly typical of the northern bird, it appears to me that they are decidedly nearer to the northern form than to the southern one. The dorsal color is very slightly darker than in the bird of the north but is distinctly paler than in *atkinsi*. The size is slightly intermediate, some having the somewhat larger dimensions of *carolinensis* and some being a little smaller. Specimens allocated here as *carolinensis* include the following: Rockwood, March 2, 13, 21, 30, and 31, 1885 (taken by W. H. Fox); Shady Valley, June 4; and 3,800 feet elevation in the Holston Mountains above Shady Valley, June 9. Dr. Oberholser [37] has listed the Rockwood specimens as the southern form, but with more material for comparison they seem to me to fit better in the northern group. They are definitely paler than *atkinsi*, and the single female shows a wash of gray over part of the black of the crown and nape. Measurements are as follows: Males (4 specimens), wings 85.8, 89.1, 89.4, 92, tail 46.7, 47.2, 47.4, 48.7, culmen from base 16.9, 18.3, 18.5, 18.5, tarsus 17.8, 18.2, 18.5, 19.4; female (1 specimen), wing 87.6, tail 46, culmen from base 17, tarsus 17 mm.

SITTA CAROLINENSIS ATKINSI Scott: Florida Nuthatch

Birds from the following localities are identified as this southern race: Reelfoot Lake, April 27; 8 miles north of Indian Mound, October 28; near Waynesboro, May 15 and 17; 7 miles southwest of Crossville, May 26. In color and in size these specimens are similar to skins from Florida and South Carolina. They are definitely darker gray on the back than *carolinensis* and average small in size. Females from Indian Mound and Crossville have the crown and hindneck black without gray overwash. The size is definitely small as indicated by the following: Males (5 specimens), wing 85.4, 87.3, 88, 88.3, 89.5, tail 45, 46.2, 47, 47.5, 47.5, culmen from base 17, 17.5, 17.6, 17.7, 18.3, tarsus 18, 18, 18.9, 18.9, 19; females (2 specimens), wing 85.6, 86.4, tail 45.7, 48.3, culmen from base 17, 17.5, tarsus 17.7, 18.5 mm. Crossville,

[37] Auk, 1917, p. 185.

where birds identified as *atkinsi* were taken, and Rockwood, where specimens called *carolinensis* were found, are not far distant, but the two series appear definitely different, though as indicated the Rockwood birds are intermediate.

The Florida nuthatch ranges well north and skins from as far north as Kershaw County, in the north-central section of South Carolina, belong to this race.

SITTA CANADENSIS (Linnaeus): Red-breasted Nuthatch

At the higher elevations on Roan Mountain these nuthatches were very common from September 13 to 23. One immature male secured on September 16 still has most of the juvenile plumage, though three others have nearly completed the molt. These birds were common also in the higher areas of the Great Smoky Mountains, where specimens were obtained at 5,000 feet on Cosby Knob, June 19, at 6,300 feet on Old Black Mountain, June 21, at 6,600 feet on Mount Guyot, June 21, 24, and 25, and at 4,700 feet on Snake Den Mountain, June 29. These are all in worn plumage, with the breast feathers so abraded that most of the reddish brown color has been lost.

Family CERTHIIDAE

CERTHIA FAMILIARIS AMERICANA Bonaparte: Brown Creeper

The following records pertain to this migrant form: Samburg, October 11; Ridgely, October 15; Rockwood, April 3, 1884, March 25 and 30 and April 15, 1885 (W. H. Fox); Lookout Mountain, March 30, 1882 (W. H. Fox).

CERTHIA FAMILIARIS NIGRESCENS Burleigh:[88] Southern Creeper

Marked by darker color above, particularly on the crown and anterior part of the body, this form is known at present in Tennessee only from the Great Smoky Mountains, where it breeds in the high elevations. Specimens were taken as follows: 6,300 to 6,600 feet elevation on Mount Guyot, June 21, 24, and 25; at 5,500 feet elevation on Inadu Knob, June 29. These are in fair plumage though somewhat worn and are decidedly darker than the migrants taken elsewhere. The birds were found on large spruces.

Family TROGLODYTIDAE

TROGLODYTES AËDON BALDWINI Oberholser: Ohio House Wren

The only house wren secured is an immature male collected 2 miles east of Phillippy, Lake County, on October 23. This is an

[88] *Certhia familiaris nigrescens* Burleigh, Proc. Biol. Soc. Washington, vol. 48, May 3, 1935, p. 62 (Mount Mitchell, N. C.).

example of this recently described race,[39] being apparently the first identification of this bird for Tennessee, though it is probable that part of the records of the western house wren (*T. a. parkmanii*) for the western part of the State refer to this form. The specimen is in a somewhat grayish phase.

NANNUS TROGLODYTES HIEMALIS (Vieillot): Eastern Winter Wren

The migrant form of the winter wren is recorded in the collection at the following points: Hickory Withe, April 10; western Lincoln County, 6 miles east of Frankewing, November 4 and 6; Rockwood, March 21, 1885, and April 3, 1884 (W. H. Fox).

While the A. O. U. Check-list has included the American wrens of this group as specifically distinct from those of the Old World, it appears that the resemblances between them are so close that they are best considered as of one species. In view of this opinion I have listed the winter wrens here under the specific name *troglodytes* instead of *hiemalis*.

NANNUS TROGLODYTES PULLUS Burleigh: Southern Winter Wren

Two winter wrens were taken at 6,200 feet elevation on Roan Mountain, a male on September 13 and one marked questionably as a female on September 20. The bird has been recorded as nesting there by A. F. Ganier,[40] but specimens were not available to Burleigh when he named this southern race. In the Great Smoky Mountains on Inadu Knob an adult male was collected at 5,400 feet on June 23, and a juvenile recently from the nest at 5,600 feet on June 28. Another juvenile comes from 6,600 feet on Mount Guyot, June 24; another from 4,500 feet on Snake Den Mountain, June 28; and an adult female from 6,300 feet on Old Black Mountain, June 29. One was observed on Snake Den Mountain at the low level of 3,600 feet on June 25.

THRYOMANES BEWICKII BEWICKII (Audubon): Bewick's Wren

An adult male was taken near Hornbeak on May 6, and three were seen near the Mississippi in the vicinity of Tiptonville on October 19. One was recorded 12 miles northwest of Waynesboro on May 13, and several were observed near Crossville, where a male was taken on May 27. Others were noted at Melvine and Pikeville on May 31 and 10 miles east of Pulaski on November 2. Immature birds recently from the nest were taken at 3,300 feet elevation on Cross Mountain, 3 miles south of Shady Valley post office, June 7.

[39] *Troglodytes domesticus baldwini* Oberholser, Ohio Journ. Sci., vol. 34, Mar. 1934, p. 90 (Gates Mills, Ohio).

[40] Migrant, 1936, p. 85.

THRYOTHORUS LUDOVICIANUS LUDOVICIANUS (Latham): Carolina Wren

This is one of the common species throughout the State, except in the higher mountains. Specimens were taken as follows: Frayser, 4 miles east of Memphis, April 8; Hickory Withe, April 9 and 10; Reelfoot Lake, April 28; Hornbeak, May 3; Ridgely, October 15; near Tiptonville, October 16; Dover, October 26; Indian Mound, October 29; Waynesboro, May 18; Pulaski, November 1; near Frankewing, November 3; Lookout Mountain, March 25 and 30, 1882 (W. H. Fox); Rockwood, March 16 and 30 and April 14, 1885 (W. H. Fox); 2,000 feet elevation in the Clinch Mountains 5 miles southwest of Bean Station, September 27; 2,900 feet in Shady Valley, June 7 (juvenile just from the nest); and 2,700 feet elevation in the Great Smoky Mountains near Cosby, June 30. This excellent series shows the usual variation in amount of reddish brown on the lower surface, birds taken in fall being much more richly colored than those in spring and summer.

CISTOTHORUS STELLARIS (Naumann): Short-billed Marsh Wren

One was seen at Reelfoot Lake on April 30.

Family MIMIDAE

MIMUS POLYGLOTTOS POLYGLOTTOS (Linnaeus): Eastern Mockingbird

The mockingbird, of State-wide distribution except in the high mountains, was collected as follows: Hickory Withe, April 10 and 12; Hornbeak, May 4; Tiptonville, October 18 and 22; Waynesboro, May 17; Pulaski, November 3; Pikeville, May 31. Mockingbirds were seen in Shady Valley on June 3 and 11.

DUMETELLA CAROLINENSIS (Linnaeus): Catbird

A common species of which specimens were obtained as follows: Eads, Shelby County, April 20; Reelfoot Lake, April 27; Waynesboro, May 10; Crossville, May 25; Rockwood, April 19, 1884 (W. H. Fox); Shady Valley, June 3; 4,200 feet elevation on Roan Mountain, September 20 and 22; 6,000 feet elevation on Inadu Knob, Great Smoky Mountains, June 26; Beans Mountain, 2 miles northeast of Parksville, July 14.

TOXOSTOMA RUFUM RUFUM (Linnaeus): Eastern Brown Thrasher

This widely distributed bird was collected at the following places: Frayser, 4 miles east of Memphis, April 8; Hickory Withe, April 8;

Hornbeak, Obion County, May 4; Reelfoot Lake, 2 miles east of Phillippy, October 9; Crossville, May 26; Rockwood, April 7; and Roane County, April 20, 1885 (W. H. Fox); Shady Valley, June 9 and 10; 4,100 feet elevation on Roan Mountain, September 20; 2,700 feet elevation 4 miles southeast of Crosby, June 23; 3,000 feet elevation on Big Frog Mountain, 8 miles southwest of Copperhill, July 10; and Beans Mountain, 2 miles northeast of Parksville, July 13 and 14.

TOXOSTOMA RUFUM LONGICAUDA (Baird): Western Brown Thrasher

An adult male taken on the Buffalo River 4 miles east of Flat Woods, Wayne County, on May 17 has the maximum size of the western race of the brown thrasher and is identified as that form. It measures as follows: Wing 110.0, tail 133.0, culmen from base 26.9, tarsus 34.2 mm. It is of necessity a migrant bird whose presence at this late date here may arouse some speculation. Possibly it had been injured in some way, though it may have been merely a belated migrant, since in the extreme northern part of the range the first arrivals do not reach the breeding grounds until May 10 or 12, and some come still later.

The western race of the brown thrasher was described originally by Baird.[41] Ridgway[42] discussed it but did not recognize it, partly because of unsatisfactory material and partly through some confusion in the allocation of some of the specimens available. Oberholser[43] has separated the western form again, and after survey of a considerable series I agree with him that it is valid. Its principal character is found in its definitely larger size. The alleged difference of paler color appears to me inconclusive, since while western birds in worn dress are lighter on the dorsal surface I can see no difference between the few specimens available in fresh fall plumage and skins in similar stage from the East. The lighter color found in the breeding series possibly is due to wear and fading through the influence of the more intense light and the drier atmosphere in which the western birds are found; in other words, to actual bleaching. Measurements of skins taken in the breeding season of the two forms are as follows:

Toxostoma rufum rufum: Males (43 specimens), wing 97.3–106.2 (102.6), tail 112.3–129.0 (121.0), culmen from base 23.1–29.2 (25.9), tarsus 31.3–36.1 (34.1) mm. Females (27 specimens), wing 96.3–103.8

[41] *Harporhynchus longicauda* Baird, Reports of explorations and surveys . . . for a railroad from the Mississippi River to the Pacific Ocean . . . Birds, vol. 9, 1858, p. 353 (Republican River, western Kansas).

[42] U. S. Nat. Mus. Bull. 50, pt. 4, 1907, p. 188.

[43] Dept. Cons. State of Louisiana Bull. 28, 1938, pp. 459–460.

(100.4), tail 111.1–126.0 (118.9), culmen from base 22.1–27.2 (25.3), tarsus 32.4–35.4 (34.0) mm. These are the birds that breed from Louisiana through eastern Kansas northward and eastward.

Toxostoma rufum longicauda: Males (18 specimens), wing 104.1–116.7 (109.5), tail 120.8–135.7 (127.5), culmen from base 24.2–29.5 (26.8), tarsus 32.7–35.8 (34.6) mm. Females (9 specimens), wing 104.4–116.6 (108.5), tail 122.0–136.7 (126.6), culmen from base 24.7–27.5 (26.0), tarsus 33.2–37.0 (34.4) mm. The specimens seen come from the Great Plains area from western Kansas and eastern Colorado (near Denver) north to Alberta and Saskatchewan. Winter and migrant birds have been examined from Texas, Mississippi, and Tennessee.

Family TURDIDAE

TURDUS MIGRATORIUS MIGRATORIUS Linnaeus: Eastern Robin

From material available it appears that this race breeds in the higher altitudes of the mountains of the eastern part of Tennessee and that it is found at other seasons through the State. Individuals off their breeding grounds were taken at Ellendale, April 17 (female, wing 129.4); Frankewing, November 6 (male, wing 130; female, wing 126.7); and Rockwood, March 3, 1885 (dark, richly colored male, wing 128.7, taken by W. H. Fox).

Four males secured in the Holston Mountains, bordering Shady Valley, on June 3, 4, 8, and 9, are large and dark colored (wings 125.9, 128.1, 129.6, and 132 mm). They were taken from the base of the mountains at 2,800 feet to 3,800 feet elevation. An immature female in spotted dress was shot at 6,200 feet on Roan Mountain, September 23. In a pair taken on June 21 on Inadu Knob in the Great Smoky Mountains, the male has the wing 132.4 mm, while in the female it measures 124.7. Both birds are dark above and are richly colored below.

TURDUS MIGRATORIUS ACHRUSTERUS (Batchelder): Southern Robin

The collection includes only a few specimens of robins from the lowlands that belong to this race, which is presumed to be the breeding form throughout most of the lowland area of the State. A female taken at Ellendale on April 17 (wing 124.7) has the pale color of the southern form. The wings are somewhat worn, and it is believed to be the breeding bird of the area. A male from Union City, May 6 (wing 125.4), is decidedly dark above but a little paler below than the average of the northern bird. It is called *achrusterus* but is considered intermediate toward *migratorius*. A female from Rockwood, with the wing 118.3 mm and the color very light above

and below, taken April 12, 1884, by W. H. Fox, is definitely the southern bird. Two females, collected along Beaverdam Creek at Shady Valley (2,900 feet elevation) on June 5 and 11, have the wing 119 and 121.4 mm, respectively, and are light in color. They appear typical of *achrusterus*, an interesting fact since specimens from the slopes of the Holston Mountains bordering the valley, and only a few miles distant, are the northern subspecies. An immature female in juvenal dress that is barely grown, taken at 2,700 feet elevation 4 miles southeast of Cosby on July 2, is referred to the southern form, as the brown of sides and flanks is pale. No adults were obtained at this point. An immature male in fall plumage taken at 6,200 feet on Roan Mountain, September 25, which represents *achrusterus*, is a fall wanderer from low elevations, since the breeding bird of this mountain is *migratorius*.

HYLOCICHLA MUSTELINA (Gmelin): Wood Thrush

Specimens were obtained as follows: Reelfoot Lake, April 29; Melvine, May 29; Rockwood, April 23, 1885 (W. H. Fox); Shady Valley, June 7 and 14; 5,100 feet elevation at White Rock, Great Smoky Mountains, July 1; 2,700 feet elevation, near Cosby, in the Great Smoky Mountains, July 2. The bird from White Rock is a juvenile only recently from the nest.

HYLOCICHLA GUTTATA FAXONI Bangs and Penard: Eastern Hermit Thrush

Found in migration as follows: Hickory Withe, April 9, 12, and 14; Reelfoot Lake 2 miles east of Phillippy, October 12; Indian Mound, October 28; Lookout Mountain, April 3, 1882 (W. H. Fox); Rockwood, March 3, 4, and 16, 1884, and April 5 and 11, 1885 (W. H. Fox).

HYLOCICHLA USTULATA SWAINSONI (Tschudi): Olive-backed Thrush

In the vicinity of Reelfoot Lake these thrushes were fairly common in spring, specimens being taken at the lake on April 27 and 28 and near Hornbeak on May 1. Numbers were seen near Waynesboro from May 11 (when one was taken) to May 17. In fall three were secured at 5,000 feet elevation on Roan Mountain, September 20 and 22.

HYLOCICHLA MINIMA ALICIAE (Baird): Gray-cheeked Thrush

Eight specimens were taken at the following localities: Reelfoot Lake, April 24 and 29; Hornbeak, May 1 and 3; near Waynesboro, May 15 and 18; and at 6,100 feet elevation on Roan Mountain, September 20.

HYLOCICHLA FUSCESCENS FUSCESCENS (Stephens): Veery

Migrants were taken 9 miles north of Waynesboro on May 11. Several were seen on Roan Mountain from September 13 to 20, one being taken on September 18. In the Great Smoky Mountains two were taken at 5,500 and 5,700 feet elevation on Inadu Knob on June 24 and 29, and two at 6,000 feet in Yellow Creek Gap on June 25.

SIALIA SIALIS SIALIS (Linnaeus): Eastern Bluebird

Except in the forested areas of the mountains bluebirds were recorded throughout the State. Specimens were obtained as follows: Hickory Withe, April 13; Hornbeak, May 4; Waynesboro, May 10 and 15; Lincoln County, 6 miles east of Frankewing, November 4, 8, and 9; Pikeville, May 31, Crossville, May 26; Shady Valley, June 5 (immature recently from nest) and June 11.

Family SYLVIIDAE

POLIOPTILA CAERULEA CAERULEA (Linnaeus): Blue-gray Gnatcatcher

This interesting species was collected as follows: Hickory Withe, April 9; Hornbeak, May 1 and 4; Waynesboro, May 10; Melvine, Bledsoe County, May 21; Lookout Mountain, March 27, 1882 (W. H. Fox); Rockwood, April 4 and 5, 1884 (W. H. Fox). Most records for this bird are made early in the season; it is seldom seen after nesting when it ceases to sing, as it is small and keeps in the cover of leaves.

REGULUS SATRAPA SATRAPA Lichtenstein: Eastern Golden-crowned Kinglet

In migration specimens come from Reelfoot Lake near Tiptonville, October 18; from Chattanooga, March 13, 1882; from Lookout Mountain, March 22, 1884; and from Rockwood March 20, 1885 (the last three taken by W. H. Fox). Possibly this kinglet is more numerous in the higher mountains as a breeding bird than has been supposed. On Roan Mountain from September 12 to 16 it was fairly common. As the specimens taken include one secured September 16 with crown still in full juvenile plumage with no trace of yellow, there can be no question that the birds nest in that region. This bird has the wings and tail just grown, while the soft immature dress still clothes the anterior part of the body. In the Great Smoky Mountains these kinglets were common in June at several localities in the high altitudes. Specimens were taken on June 24 and 26 at 6,400 to 6,600 feet elevation on Mount Guyot, and on June 21 at 6,300 feet on Old Black Mountain. One taken on June 21 is only recently from the nest and is in full juvenal plumage. Several were seen on Inadu Knob on June 24.

Breeding birds are almost imperceptibly darker in color above when compared with birds from the north, but they do not seem to differ sufficiently to warrant separation.

Regulus satrapa and its races differ from *Regulus regulus* and its forms of the Old World definitely and strikingly in the well-marked white superciliary line of the former. The only approach in the Palearctic group to this character is found in *Regulus regulus japonicus*, in which the whole side of the head is lighter but in which there is no definite superciliary stripe. In fact, to my eye *satrapa* resembles *Regulus ignicapillus* as much as it does *R. regulus*. I may add that the song of the goldcrest (*Regulus r. regulus*), familiar to me in the field from work in the Sierra Cantabrica of northern Spain, is quite distinct in form and phrase from that of our golden-crown. I can see no basis for the action of Hartert,[44] Hellmayr,[45] and others in listing the North American *satrapa* as a geographic race of *regulus*. In my opinion the two should be treated in our Check-list as distinct.

CORTHYLIO CALENDULA CALENDULA (Linnaeus): Eastern Ruby-crowned Kinglet

Obtained in migration as follows: Frayser, April 8; Hickory Withe, April 14; Samburg, October 14; Ridgely, October 15; Pulaski, November 2; Rockwood, April 3, 1884 (W. H. Fox); 2,000 feet elevation in the Clinch Mountains, 3 miles west of Bean Station, September 28 and 30; Roan Mountain at 6,200 feet elevation, September 15 and 18, and at 4,900 feet, September 20.

Family MOTACILLIDAE

ANTHUS SPINOLETTA RUBESCENS (Tunstall): American Pipit

On March 23 and 24, 1885, W. H. Fox secured specimens of the pipit at Rockwood.

Family BOMBYCILLIDAE

BOMBYCILLA CEDRORUM Vieillot: Cedar Waxwing

Cedar waxwings were taken at Hickory Withe, April 15, and at Reelfoot Lake, April 27. Birds were seen at Waynesboro, May 11; near Frankewing, November 7; and on Cross Mountain near Shady Valley, June 13. One was collected at 6,100 feet elevation on Old Black Mountain in the Great Smoky Mountains on June 29.

[44] Die Vögel der paläarktischen Fauna, vol. 1, 1910, p. 394.
[45] Field Mus. Nat. Hist., zool. ser., vol. 13, pt. 7, 1934, p. 510.

Family LANIIDAE

LANIUS LUDOVICIANUS MIGRANS Palmer: Migrant Shrike

While Tennessee occupies an intermediate area between the ranges of the migrant and the loggerhead shrikes, the six specimens in the National Museum are referred to the northern form. A female secured at Ellendale, Shelby County, on April 21 is distinctly light colored and is assigned to *migrans* without hesitation. Three from the vicinity of Reelfoot Lake, a male from Samburg, May 4, a female from 6 miles north of Tiptonville, October 6, and a male from 2 miles east of Phillippy, October 7, are all light colored, the spring bird being a little darker than the others owing apparently to adventitious stain. A male from 2 miles north of Pikeville in Bledsoe County, May 31, is considerably worn and is darker than the others, being decidedly intermediate toward *ludovicianus*. It seems nearer, however, to *migrans*. A female from Rockwood, taken on March 18, 1885, by W. H. Fox, agrees with *migrans*. A considerable series will be necessary to establish the status of the shrikes of the entire State.

Family STURNIDAE

STURNUS VULGARIS VULGARIS Linnaeus: Starling

Starlings were observed during the nesting season as follows: Union City, April 30 and May 1; Waynesboro, May 10, 11, and 19; Pikeville, May 28 to 31; Farragut, Rutledge, Surgoinsville, and Holston Valley, June 1; Shady Valley, June 8 and 10. One or two were recorded on each of the dates mentioned except at Shady Valley, where the birds were found in small flocks. The only specimens collected were two shot near Pulaski, November 3, where starlings were flocking with grackles.

Family VIREONIDAE

VIREO GRISEUS GRISEUS (Boddaert): White-eyed Vireo

A common species that was collected as follows: Hickory Withe, April 10 and 14; Reelfoot Lake, April 30 (one seen here October 7); 4 miles west of Hornbeak, May 1 and 3; near Waynesboro, May 10, 12, and 18; Rockwood, April 15 and 16, 1884, and April 17, 1885 (taken by W. H. Fox); 2,900 feet elevation in Shady Valley, June 7; and 2,700 feet elevation 4 miles southeast of Cosby in the Great Smoky Mountains. White-eyed vireos were fairly common in Shady Valley in June.

VIREO FLAVIFRONS Vieillot: Yellow-throated Vireo

Taken at Hickory Withe, April 10 and 14; Reelfoot Lake, April 26 and 27; 8 miles north of Waynesboro, May 17; Rockwood, April 14, 1885 (W. H. Fox); Clinch Mountains, 6 miles southwest of Bean Station, September 29; on Beaverdam Creek at Shady Valley, June 6.

VIREO SOLITARIUS SOLITARIUS (Wilson): Blue-headed Vireo

Four of the specimens examined are of this migrant form. They were obtained as follows: 2 miles east of Phillippy, October 23; 10 miles north of Waynesboro, May 10; and Rockwood, April 15 and 17, 1885 (W. H. Fox).

VIREO SOLITARIUS ALTICOLA Brewster: Mountain Vireo

An excellent series was obtained in the mountains along the eastern border of the State at the following localities: Near Shady Valley, at 3,800 feet elevation in the Holston Mountains, June 4, and at 4,000 feet in the Iron Mountains, June 6; at 6,100 feet altitude on Roan Mountain, September 13; in the Great Smoky Mountains, at 2,900 feet above sea level 4 miles southeast of Cosby June 30, at 6,350 feet on Old Black Mountain June 21 and 25, on Inadu Knob June 21 and 24, and at 6,600 feet on Mount Guyot June 25; and at elevations ranging from 2,100 feet to 3,000 feet on Big Frog Mountain, 8 miles southwest of Copperhill, July 9, 10, and 14. A male was taken on Lookout Mountain on March 25, 1882, by W. H. Fox. Among the birds from Big Frog is one juvenile that is barely grown.

VIREO OLIVACEUS (Linnaeus): Red-eyed Vireo

A common species during summer throughout the State. Records are as follows: Hickory Withe, April 15 and 16; Reelfoot Lake, April 26, 27, and 30; 10 miles north of Waynesboro, May 10; Melvine, Bledsoe County, May 21; 7 miles southwest of Crossville, May 24 and 26; Rockwood, April 16, 1884 (W. H. Fox); Shady Valley, June 2, 3, and 7; 2,700 feet to 3,200 feet elevation, 4 miles southeast of Cosby in the Great Smoky Mountains, June 23 and 29; 2,100 feet elevation on Big Frog Mountain, 8 miles southwest of Copperhill, July 9 and 15 (including one young bird on July 9 just from the nest); 2,900 feet elevation on Beans Mountain, 2 miles northeast of Parksville, July 14 (a young bird just from the nest).

In the course of preparation of the fourth edition of the Check-list of North American Birds, the A. O. U. Committee considered

the proposal of Bangs and Penard [46] to call the red-eyed vireo *Vireo virescens* on the grounds that the name *Motacilla olivacea* Linnaeus in use for it could not properly be applied to this species, but they did not find sufficient reason for discarding the current name. The same question has been revived recently by Hellmayr.[47]

Family COMPSOTHLYPIDAE

MNIOTILTA VARIA (Linnaeus): Black and White Warbler

The present species was fairly common during summer in the eastern two-thirds of Tennessee, as shown by the following records: 10 miles north of Waynesboro, May 12; 7 miles southwest of Crossville, May 24 and 25; Lookout Mountain, March 24, 1882 (W. H. Fox); Rockwood, March 31, 1885, and April 5 and 11, 1884 (W. H. Fox); Shady Valley, June 7 and 8; 6,000 feet elevation on Roan Mountain, September 20; 5,000 feet elevation on Inadu Knob, Great Smoky Mountains, June 26; 2,700 feet elevation, 4 miles southeast of Cosby, June 30 and July 2; 2,100 feet elevation on Big Frog Mountain, 8 miles southwest of Copperhill, July 9 and 15 (including immature birds not quite grown on both dates).

PROTONOTARIA CITREA (Boddaert): Prothonotary Warbler

The brilliant prothonotary warbler was seen at Hickory Withe on April 10. At Reelfoot Lake, where three specimens were taken on April 27 and 29 and May 7, these birds were common, particularly on Green and Caney Islands. One was seen near Tiptonville on May 1.

LIMNOTHLYPIS SWAINSONII (Audubon): Swainson's Warbler

On June 8 an adult male was taken at 3,000 feet elevation in the Holston Mountains, 3 miles northeast of Shady Valley, in a swampy area shaded heavily with hemlock and rhododendron. Two others were recorded at 2,600 feet elevation 5 miles north of Shady Valley, near Beaverdam Creek.

HELMITHEROS VERMIVORUS (Gmelin): Worm-eating Warbler

The first one observed was found 8 miles north of Waynesboro on May 16. W. H. Fox secured a male at Rockwood April 24, 1884, and Perrygo and Lingebach obtained one at 3,000 feet elevation on Big Frog Mountain 8 miles southwest of Copperhill on July 10.

[46] Bull. Mus. Comp. Zoöl., vol. 67, 1925, p. 206.
[47] Field Mus. Nat. Hist., zool. ser., vol. 18, pt. 8, Sept. 16, 1935, p. 130.

VERMIVORA PEREGRINA (Wilson): Tennessee Warbler

A common migrant that was obtained in spring at Reelfoot Lake on April 27 and 30, and in fall in this general area, near Samburg on October 11, and near Tiptonville on October 16 and 18. One was seen 8 miles north of Waynesboro on May 19. Two were collected at 6,200 feet elevation on Roan Mountain on September 13.

VERMIVORA CELATA CELATA (Say): Orange-crowned Warbler

An immature male was secured along the Cumberland River on October 26 near Dover.

COMPSOTHLYPIS AMERICANA AMERICANA (Linnaeus): Southern Parula Warbler

A male taken at Rockwood on April 24, 1884, by W. H. Fox has the paler upper surface and less heavily banded breast of the southern race. It has the following measurements: Wing 59.4, tail 42.8, culmen from base 11.7, and tarsus 15.5 mm. Whether this individual is a wanderer or whether the southern form has a definite range in the State is something to be ascertained only through further collecting. All others taken belong to the subspecies *pusilla*.

COMPSOTHLYPIS AMERICANA PUSILLA (Wilson): Northern Parula Warbler

Birds from the following localities are identified as this race: Reelfoot Lake, April 24; about 4 miles west of Hornbeak, May 3; Birds Creek, 7 miles southwest of Crossville, May 24, 25, and 27; and Shady Valley, June 10. All are heavily banded with black and brown across the chest and are darker above than the southern form.

DENDROICA AESTIVA AESTIVA (Gmelin): Eastern Yellow Warbler

A female was taken at Reelfoot Lake on April 27. Others were seen near Hornbeak on May 4 and at Shady Valley on June 3.

DENDROICA MAGNOLIA (Wilson): Magnolia Warbler

Two were collected, an adult male 10 miles north of Waynesboro on May 12, and a female in the Clinch Mountains, 3 miles west of Bean Station, on September 28.

DENDROICA TIGRINA (Gmelin): Cape May Warbler

There is one specimen of this warbler in the National Museum collections taken at Rogersville, Tenn., in May 1885, by James Rogan.

DENDROICA CAERULESCENS CAERULESCENS (Gmelin): Black-throated Blue Warbler

On September 13 Perrygo noted hundreds of these warblers passing over Roan Mountain during a heavy fog. This was the period of migration from the north, and several specimens of this northern race were taken here at elevations varying from 4,700 to 6,200 feet between September 13 and 20. These are the only certain records for true *caerulescens* in the collection.

DENDROICA CAERULESCENS CAIRNSI Coues: Cairns's Warbler

In June in the Holston Mountains bordering Shady Valley these birds were common, specimens being taken on June 4 and 9. I saw several in the Iron Mountains on June 6 and one on Cross Mountain south of Shady Valley on June 7. On Roan Mountain, among the host of migrant black-throated blue warblers, a male of this race was taken at 6,200 feet on September 13 and another at 5,000 feet on September 23. In the Great Smoky Mountains Cairns's warbler was common, being collected in Low Gap 6 miles southeast of Cosby on June 19, when an adult male and a young bird recently from the nest were taken, and on Inadu Knob June 21, 24, and 26. Two were seen at 3,700 feet on Big Frog Mountain on July 10. The males have the blue dark in color, and most of them show a heavy suffusion of black in the back. The females are darker and duller than those of the northern form. The young bird secured is decidedly different from the only juvenile of the black-throated blue warbler available, a bird just from the nest taken at Upton, Maine, on August 11, 1873, by William Brewster (U. S. N. M. no. 233447), the specimen of Cairns's warbler being much darker colored on the back, and decidedly greenish instead of brown. The difference is striking.

DENDROICA CORONATA CORONATA (Linnaeus): Myrtle Warbler

This species, abundant at the proper seasons, was taken as follows: Hickory Withe, April 15 and 16; Reelfoot Lake, April 27 and October 13 (4 miles south of Samburg); 7 miles northeast of Tiptonville, October 22; Cumberland River near Indian Mound October 27 (hundreds seen here on the following day); 10 miles east of Pulaski, November 2; Lookout Mountain, March 29, 1882 (W. H. Fox); and Rockwood, March 3, 1885 (W. H. Fox).

As I have stated elsewhere, I consider the western race of this bird valid, though it is not recognized in the latest edition of the A. O. U. Check-list.

DENDROICA VIRENS VIRENS (Gmelin): Black-throated Green Warbler

Specimens at hand come from the following localities: Hornbeak, May 1; Samburg, October 19; Rockwood, April 3 and 7, 1884 (W. H. Fox); 3,400 feet elevation on Cross Mountain (near Briceville), August 15, 1908 (A. H. Howell); Clinch Mountains near Bean Station, September 28 and 29; 5,700 feet elevation on Roan Mountain, September 16; 3,200 to 3,400 feet altitude near Cosby, June 30 and July 1; 3,800 feet elevation on Snake Den Mountain, July 2; 2,100 feet elevation on Big Frog Mountain, 8 miles southwest of Copperhill, July 9. Apparently these birds are commoner as nesting birds in the State than has been supposed. The specimens from Cross Mountain probably were summer residents. In the Great Smoky Mountains two were seen on Mount Guyot at 6,600 feet in addition to those listed. On Big Frog Mountain black-throated green warblers were common, as 15 were noted one day. Those taken there include young birds recently from the nest.

From the few specimens that I have seen, the southern race of this species, *Dendroica virens waynei*, is distinguished only by its somewhat smaller and slenderer bill. To me color differences that have been alleged are not apparent. The breeding birds from Tennessee resemble birds from the north and are to be placed with the typical race.

DENDROICA CERULEA (Wilson): Cerulean Warbler

A male was taken 8 miles north of Waynesboro on May 19. One was recorded 7 miles southwest of Crossville on May 25.

DENDROICA FUSCA (Müller): Blackburnian Warbler

The first one observed was taken at Reelfoot Lake, April 24, followed by others 4 miles west of Hornbeak, May 4, and 9 miles north of Waynesboro, May 11. A female was secured on June 4, at 3,800 feet in the Holston Mountains above Shady Valley, and on June 6 I found Blackburnian warblers common along the summit of the Iron Mountains 2 miles east of Shady Valley, where I secured a pair. We saw at least a dozen at an elevation of 4,000 feet in deciduous forest, where they ranged both through the higher trees and in the undergrowth. Subsequently Perrygo found them on Inadu Knob in the Great Smoky Mountains, at elevations of 5,700 to 5,900 feet on June 23, 24, and 26.

Female birds taken in June appear less yellowish above than those from the north, the white markings being clearer and the general tone grayer and darker. There is much individual variation in this

species, however, and it seems probable that the difference apparent is due to this. One breeding male is similar to skins from the north.

DENDROICA DOMINICA ALBILORA Ridgway: Sycamore Warbler

Specimens were obtained near Hickory Withe on April 10, 12, and 16 and at Reelfoot Lake on April 29. Others were observed in the latter region on May 1 and 7.

DENDROICA PENSYLVANICA (Linnaeus): Chestnut-sided Warbler

Recorded as follows: 4 miles west of Hornbeak, May 4; Cross Mountain, 3 miles south of Shady Valley, June 7; and near Cosby, in the Great Smoky Mountains, June 21 and July 1.

DENDROICA CASTANEA (Wilson): Bay-breasted Warbler

This migrant species was taken near Hornbeak on May 1 and at Reelfoot Lake on May 7. In fall it was fairly common in this area, specimens coming from near the lake, 2 miles east of Phillippy, October 9 and 12, and from 4 miles below Samburg, October 13. A number were seen near Samburg on October 19. North of Waynesboro specimens were secured on May 10 and 11, and one was seen on May 12. In the Clinch Mountains one was taken 5 miles southwest of Bean Station, September 27, and one 3 miles northwest of Rutledge, October 1. One was collected at 5,200 feet elevation on Roan Mountain on September 23.

DENDROICA STRIATA (Forster): Black-poll Warbler

About Reelfoot Lake this species was collected on April 27 and 28. Others were seen near Bluebank on May 3 and Hornbeak on May 4, while on May 7 they were very common on Green and Caney Islands in Reelfoot Lake. A few were recorded near Waynesboro on May 11 and 12.

Hellmayr[48] has listed this species under the name *Dendroica breviunguis* (Spix) on the ground that "*Muscicapa striata* Forster seems to be barred by *Motacilla striata* Pallas (in Vroeg, Cat. Rais. d'Ois., Adumbr., p. 3, 1764) now referred to the genus *Muscicapa*."

While this is true under the International Code, which recognizes secondary synonyms, it does not hold under the A. O. U. code as at present constituted, as this does not recognize secondary allocation of names as preoccupation unless in current usage they come within the limits of the same genus. If the A. O. U. code is followed, the name

[48] Field Mus. Nat. Hist., zool. ser., vol. 13, pt. 8, 1935, p. 403.

of this warbler will remain *striata*. If the International Code is accepted, then the name will change to *breviunguis*.

DENDROICA PINUS PINUS (Wilson): Northern Pine Warbler

W. H. Fox collected pine warblers at Rockwood on March 13 and 26, 1885. Perrygo secured one in the Clinch Mountains 6 miles southwest of Bean Station on September 29 and one at 6,200 feet elevation on Roan Mountain on September 22. On Big Frog Mountain young recently from the nest were taken on July 9 at 2,100 feet elevation, 8 miles southwest of Copperhill. Another young bird molting into first fall plumage was secured on July 14.

DENDROICA DISCOLOR DISCOLOR (Linnaeus): Northern Prairie Warbler

Near Waynesboro these birds were common from May 10 to 15. Specimens were taken also near Crossville, May 24, 25, and 26, and there are two in the National Museum taken by W. H. Fox near Rockwood, April 15, 1885, and April 16, 1884.

DENDROICA PALMARUM PALMARUM (Gmelin): Western Palm Warbler

Fairly common in the general vicinity of Reelfoot Lake from April 26 to May 7. Specimens were taken at Reelfoot Lake on April 26 and near Hornbeak on May 4.

SEIURUS AUROCAPILLUS (Linnaeus): Oven-bird

Records for this common bird are as follows: 4 miles west of Hornbeak, May 3; 5 miles east of Crossville, May 29; Rockwood, May 15, 1884 (W. H. Fox); Clinch Mountains, 3 miles west of Bean Station, September 30; Shady Valley, June 2 and 4 (common in the Holston and Iron Mountains); Carter, June 7; Low Gap in the Great Smoky Mountains near Cosby, June 19; 3,000 to 3,200 feet elevation on Big Frog Mountain 8 miles southwest of Copperhill, July 10 (one immature bird); 2,900 to 3,000 feet elevation on Beans Mountain 2 miles northeast of Parksville, July 13 and 14 (the latter an immature individual).

SEIURUS MOTACILLA (Vieillot): Louisiana Water-thrush

A small series taken during the spring months includes specimens from the following localities: Hickory Withe, April 9 and 16; Reelfoot Lake, April 28; 7 miles southwest of Crossville, May 25; Melvine, May 29 and 31; Rockwood, April 12, 1884 (W. H. Fox); Holston Mountains near Shady Valley, June 3 (including a young bird just

from the nest); 3,600 feet elevation in the Iron Mountains above Shady Valley, June 6 (others seen at Shady Valley post office and on Cross Mountain, June 7); at 2,900 feet elevation near Cosby in the Great Smoky Mountains, June 29; 2,000 feet elevation on Big Frog Mountain near Copperhill, July 8 (one juvenile).

OPORORNIS FORMOSUS (Wilson): Kentucky Warbler

Found at Hickory Withe, April 16; Eads, April 20; Reelfoot Lake, April 28; Hornbeak, May 1 and 3; Waynesboro, May 10 to 19; Crossville, May 25 to 28; Shady Valley, June 11; Low Gap in the Great Smoky Mountains near Cosby, June 19; 3,500 feet elevation 4 miles southeast of Cosby, June 29.

GEOTHLYPIS TRICHAS BRACHIDACTYLA (Swainson): Northern Yellow-throat

Specimens were secured as follows: Eads, April 20; Ellendale, April 17 and 21; Hickory Withe, April 20; Reelfoot Lake, April 28 and 30; Waynesboro, May 17; Crossville, May 26; Rockwood, April 23, 1885 (W. H. Fox); Shady Valley, June 5 and 11; and at 6,100 feet elevation on Inadu Knob, in the Great Smoky Mountains, June 26. Males from Shady Valley are very slightly larger than others. All have the yellow on the lower surface extensive.

ICTERIA VIRENS VIRENS (Linnaeus): Yellow-breasted Chat

Specimens were taken at Reelfoot Lake, April 30; 10 miles north of Waynesboro, May 12; near Crossville, May 26, 27, and 28; Rockwood, April 23, 1885 (W. H. Fox); Shady Valley, June 16; at 2,700 and 2,800 feet elevation near Cosby, in the Great Smoky Mountains, June 23 and 29; at 3,000 feet on Big Frog Mountain 8 miles southwest of Copperhill, July 10; and at 1,800 feet on Beans Mountain, 2 miles northeast of Parksville, July 14.

Birds from near Reelfoot Lake have slightly more white on the malar region than those from the eastern part of the State but in no other way show approach to the western form.

WILSONIA CITRINA (Boddaert): Hooded Warbler

Records for this species are as follows: Hickory Withe, April 14; Hornbeak, May 1; 10 miles north of Waynesboro, May 12; 7 miles southeast of Crossville, May 25; Rockwood, May 19, 1884 (W. H. Fox); Shady Valley, June 7 and 10; Low Gap, June 19, and 3,700 feet elevation on Snake Den Mountain, June 24, in the Great Smoky Mountains (seen near Cosby June 19); Big Frog Mountain, 8 miles southwest of Copperhill, July 14 and 15; Beans Mountain, 2 miles northeast of Parksville, July 14 (including one young just from nest).

WILSONIA CANADENSIS (Linnaeus): Canada Warbler

Taken only in the Great Smoky Mountains, where specimens were secured at 5,000 feet on Cosby Knob, June 19, on Inadu Knob, June 21, and at 4,200 feet on Snake Den Mountain, June 26.

Breeding specimens from the mountains of North Carolina (Mount Mitchell, Graybeard, and Roan Mountain), Tennessee (Great Smoky Mountains), southwestern Virginia (White Top and Mount Rogers), and West Virginia (Middle Mountain, Yokum Knob, and Cranberry Glades) are very faintly darker gray above, with slightly less greenish yellow wash, than those from the northern United States and southern Canada. The difference is barely perceptible on close comparison and is not one that in my opinion merits a name.

SETOPHAGA RUTICILLA (Linnaeus): Redstart

The following specimens were taken: Eads, April 20; Hornbeak, May 3; 10 miles north of Waynesboro, May 12; 7 miles southwest of Crossville, May 25; Rockwood, April 15, 1885 (W. H. Fox); Roan Mountain, September 16 and 23.

Family PLOCEIDAE

PASSER DOMESTICUS DOMESTICUS (Linnaeus): English Sparrow

A female was taken at Indian Mound on October 29, and a male was collected at Rockwood on March 24, 1885 (by W. H. Fox).

Family ICTERIDAE

DOLICHONYX ORYZIVORUS (Linnaeus): Bobolink

Seen 2 miles north of Waynesboro on May 17 and 18.

STURNELLA MAGNA ARGUTULA Bangs: Southern Meadowlark

Study of the meadowlarks available from Tennessee has brought to light an interesting condition in that while all I have seen are to be identified as the southern form *argutula*, those from the eastern section of the State are intermediate toward the northern bird.

Specimens from the following localities are considered typical of the southern race: Ellendale, April 17; 7 miles northeast of Tiptonville, October 22; Union City, May 4 and 6; 4 miles east of Waynesboro, May 17; Fayetteville, November 3; Pikeville, May 31. Measurements of birds in this series are as follows: Males, wing 111.8–121.0, tail, 71.6–78.3, culmen from base 31.5–36; tarsus 39.6–44; females, wing 103.5–106.6, tail 62.8–72.1, culmen from base 28.6–31.5, tarsus 36.7–39.3 mm.

In specimens from farther east the color of the breast is distinctly paler yellow as in *magna*, while the size remains small and the dorsal coloration is dark as in *argutula*. These are considered intermediate but as nearer to *argutula*. This series includes the following birds: Rockwood, April 15, 17, and 23, 1885 (W. H. Fox); Shady Valley, June 11. The specimens measure as follows: One male (from Shady Valley), wing 115.6, tail 70.3, culmen from base 33.2, tarsus 41.4; four females, wing 101–108, tail 62.8–70.1, culmen from base 27.8–32.1, tarsus 35.6–38.3 mm. These all seem to be breeding birds and may indicate that *S. m. magna* is found in Tennessee only as a winter migrant.

A bird that I collected in the Elk Gardens at 4,000 feet elevation on White Top Mountain, Va., on September 28, 1935, agrees in dark dorsal coloration with the birds from Shady Valley, Tenn., though as it is in molt comparative measurements are not available.

AGELAIUS PHOENICEUS PHOENICEUS (Linnaeus): Eastern Red-wing

Specimens of this common bird were secured as follows: Ellendale, April 21; Hickory Withe, April 20; Tiptonville, October 8; Phillippy, October 23; Reelfoot Lake, May 7; Indian Mound, October 29; Rockwood, March 13 and April 17, 1885 (W. H. Fox); Shady Valley, June 11, 12, and 14.

AGELAIUS PHOENICEUS ARCTOLEGUS Oberholser: Giant Red-wing

In the small series of red-wings obtained there are two females that are migrants of this large northern race. One taken at Ellendale, Shelby County, April 17, with the wing 101.4 mm, is noticeable for the wide, heavy, black streaks on the under surface and the dark coloration above. Another secured 7 miles northeast of Tiptonville on October 20 is larger, having the wing 104 mm. It also is heavily marked below and is especially noticeable for its dark color above.

ICTERUS SPURIUS (Linnaeus): Orchard Oriole

Specimens were taken at Eads, April 22; Hickory Withe, April 22; and Reelfoot Lake, April 26. The bird was observed near Waynesboro, May 11 to 18, and in the vicinity of Pikeville, May 21 to 29.

ICTERUS GALBULA (Linnaeus): Baltimore Oriole

Several were seen and two were taken at Reelfoot Lake on April 30, Others were seen near Hornbeak on May 3 and 4 and on Caney Island in Reelfoot Lake on May 7.

EUPHAGUS CAROLINUS (Müller): Rusty Blackbird

One was taken from a flock of three along the Cumberland River near Dover on October 26. There is also a female in the collection from Rockwood taken on April 18, 1885, by W. H. Fox.

QUISCALUS VERSICOLOR Vieillot: Bronzed Grackle

This form of grackle has the back and rump metallic bronze without concealed purplish bars, except at the point of junction of the head color with that of the back. It is represented in the collection by birds typical in every way that are supposed to have been breeding, taken at Hickory Withe, April 15, and at Union City, May 4. A female from Hickory Withe has not molted properly and is in such worn plumage that practically all metallic sheen has disappeared except on the head and upper breast. In fall, specimens were obtained at Reelfoot Lake, 3 miles south of Samburg, October 11, on the Cumberland River, 7 miles north of Dover, October 30, and near Pulaski in Giles County, November 1.

I have indicated beyond that this bird is probably best treated as a species distinct from the purple and Florida grackles of the east and south, and now it is with much regret that I have to record that the long-familiar name of *aeneas* proposed by Ridgway [49] for this grackle has to be replaced by *versicolor* of Vieillot,[50] a name at one time used for the purple grackle. Hellmayr [51] has listed *Quiscalus versicolor* Vieillot as a synonym of *Quiscalus quiscula quiscula*, saying that it is a "new name for *Gracula quiscula* Latham (Ind. Orn., 1, p. 191, 1790) = *Gracula quiscula* Linnaeus." There is, however, in the Museum d'Histoire Naturelle in Paris a specimen that is marked definitely as Vieillot's type of *versicolor* and that is a typical bronzed grackle, so that this name must be used for the western bird. In May 1938, in company with A. J. van Rossem, I examined this specimen to find that there is no question as to its identification as indicated, and there seems to be no doubt that it is the basis of Vieillot's description. Hellmayr's supposition that *versicolor* is merely a substitute name for *Gracula quiscula* Latham is not borne out by examination of Vieillot's account, which is not a transliteration of Latham's statement but is written anew, evidently from the specimen cited. The type is labeled as from "États-Unis."

The name for the bronzed grackle, therefore, becomes *Quiscalus versicolor* Vieillot if it is considered a distinct species, or *Quiscalus*

[49] Proc. Acad. Nat. Sci. Philadelphia, 1869, p. 134.

[50] *Quiscalus versicolor* Vieillot, Nouv. Dict. Hist. Nat., vol. 28, 1819, p. 488, pl. P. 3, fig. 1 (no locality given).

[51] Field Mus. Nat. Hist., zool. ser., vol. 13, pt. 10, 1937, p. 75.

versicolor versicolor if the belief is held that it is conspecific with the eastern and southern grackles of this group.

QUISCALUS QUISCULA STONEI Chapman: Purple Grackle

The subspecific names applied herein to this grackle and its relative "*ridgwayi*" are used in accordance with the treatment of Dr. Frank M. Chapman in his detailed studies of these interesting birds.[52] In the identification of the specimens available from Tennessee I have had the benefit of Dr. Chapman's advice from his personal examination of the material.

In my opinion the nomenclatural status of these grackles is subject to some adjustment from the currently accepted view as expressed at present in the A. O. U. Check-list of one species divided into several subspecies. As knowledge of the ranges of the phases in which these birds occur has grown, it has appeared to me that we have here two specific groups, one of bronzed grackles (not divided into subspecies) and the other of purple grackles (with two geographic races, the Florida grackle and the purple grackle), with hybrids (*ridgwayi*) occurring in abundance when the ranges of the two overlap. If this view is accepted, the case would then be like that of the red-shafted and the yellow-shafted flickers.

Four birds assigned to the purple grackle now known as *Quiscalus q. stonei* were secured by W. H. Fox near Rockwood, Tenn., on March 26 and 30 and April 11 and 16, 1885. These show the purplish to greenish head, the bronzy purplish blue back and sides, and the more or less concealed iridescent bars on the back, especially on the rump, that mark the race here under discussion. The April specimens are presumably breeding birds. Those collected in March may have been migrants, or they may have been taken on their breeding grounds.

QUISCALUS QUISCULA RIDGWAYI Oberholser: Ridgway's Grackle

As used by Dr. Chapman, birds to which this name may be applied have the back and sides brassy green, and the rump bronze without evident or concealed iridescent bars. The group to which this name is applied is one that is definitely variable, and as indicated above it seems probable that it represents a series of hybrids between birds of the purple grackle complex and the bronzed grackle. Among specimens taken by W. H. Fox at Rockwood is a male, secured on March 26, 1885, that is entirely typical of this supposed form. The back is brassy green with evident iridescent bluish bars and the rump plain bronze, without markings. A female secured on April 11, 1885,

[52] Auk, 1935, pp. 21–29; 1936, pp. 405–416.

has a bare indication of bars on the rump and so approaches *stonei*, though another male taken on April 20, 1885, in somewhat worn breeding dress, shows somewhat more of an approach toward the bronzed grackle in the more greenish cast of the dorsal surface, though this appearance may be due to feather wear. Other birds of the *ridgwayi* type were secured by Perrygo at Shady Valley, Johnson County, on June 11 and 14, 1937. A male and two females are typical in color of the birds placed under this name. A third female shows a little more approach to *stonei*.

These birds are segregated under the name *ridgwayi* as a matter of convenience, but I believe they are hybrids and therefore are to be doubtfully considered as a separate subspecific group.

MOLOTHRUS ATER ATER (Boddaert): Eastern Cowbird

In Lake and Obion Counties the cowbird was fairly common from April 24 to May 7, specimens being taken at Reelfoot Lake on April 26 and 4 miles west of Hornbeak on May 3. Others were collected in the vicinity of Waynesboro on May 17 (4 miles east of Flat Woods) and May 19 (8 miles north). One was collected at Rockwood on April 17, 1885, by W. H. Fox. Perrygo recorded cowbirds at Crossville, May 29, 4 miles east of Knoxville, June 1, and Shady Valley, June 9, 10, and 11.

Family THRAUPIDAE

PIRANGA ERYTHROMELAS Vieillot: Scarlet Tanager

Specimens were obtained at the following localities: Reelfoot Lake, April 29; 10 miles north of Waynesboro, May 10; Melvine, May 21; 7 miles southwest of Crossville, May 24; Rockwood, April 19, 1884 (W. H. Fox); Shady Valley, June 3 and 15; Great Smoky Mountains, Low Gap, near Cosby, June 19, and 3,700 feet elevation on Snake Den Mountain, June 24; and 2,100 feet elevation on Big Frog Mountain, 8 miles southwest of Copperhill, July 15. Two males in the nine taken have red markings in the middle wing coverts. Two others (the last two listed) have only partially attained adult color, the red being dull, with considerable mixture of greenish.

PIRANGA RUBRA RUBRA (Linnaeus): Summer Tanager

While all the records of this tanager are for spring, it is probable that the birds noted were on their nesting grounds. Specimens were collected at Hickory Withe, April 15 and 16; Reelfoot Lake, April 28; near Waynesboro, May 11 and 12.

Family FRINGILLIDAE

RICHMONDENA CARDINALIS CARDINALIS (Linnaeus): Eastern Cardinal

This abundant resident was recorded throughout the State except in the higher elevations of the eastern mountains. Cardinals were common in Shady Valley and were found to at least 3,300 feet in the Holston Mountains. In the Great Smoky Mountains they were seen near Cosby at 2,700 feet, and they were found on Big Frog and Beans Mountains.

Specimens were obtained at the following localities: Frayser, April 8; Hickory Withe, April 12; Reelfoot Lake, April 26; Phillippy, October 7; Samburg, October 13; Dover, October 25; Indian Mound, October 27; Waynesboro, May 11 and 17; Frankewing, November 3 and 4; Lookout Mountain, March 24, 1882 (W. H. Fox); Crossville, May 25; Rockwood, April 16, 1884, and Roane County, April 6, 1885 (W. H. Fox); Bean Station, October 2; Shady Valley, June 10 and 12; near Cosby in the Great Smoky Mountains, July 3.

HEDYMELES LUDOVICIANUS (Linnaeus): Rose-breasted Grosbeak

While these birds were noted at Eads, April 20, Hornbeak, May 1 and 4, and Samburg, May 7, the only one collected in the western section of the State was a female secured 7 miles northeast of Tiptonville on October 19. Near Shady Valley I saw one at 4,000 feet in the Iron Mountains on June 6, and Perrygo observed a pair at 3,800 feet in the Holston Mountains on June 10. In the Great Smoky Mountains several were seen on Inadu Knob, in Low Gap, and on White Rock, between June 19 and July 2, and an adult male was taken on the latter date at 5,000 feet on Inadu Knob. The most interesting specimen is an adult female secured on July 10 at 3,700 feet elevation on Big Frog Mountain, 8 miles southwest of Copperhill. This bird has the lower throat, the upper breast, and an indefinite line down the center of the breast antimony yellow, a marking that I have not observed in any other specimen. From September 20 to 23 rose-breasted grosbeaks were common at 4,000 to 5,000 feet on Roan Mountain, when several were taken. It is probable that part of these were migrants.

PASSERINA CYANEA (Linnaeus): Indigo Bunting

This handsome bunting is State-wide in its distribution, having been noted everywhere except in the higher altitudes. Specimens were taken as follows: Reelfoot Lake, May 4 and October 7; near Hornbeak, May 3 and 4; 7 miles northeast of Tiptonville, October

22; Waynesboro, May 17; Pikeville, May 31; Bean Station, October 2; Shady Valley, June 4 and 10; near Cosby in the Great Smoky Mountains, June 23 and 30; 2,000 to 2,300 feet on Big Frog Mountain, 8 miles southwest of Copperhill, July 8, 10, and 15.

SPIZA AMERICANA (Gmelin): Dickcissel

In the vicinity of Reelfoot Lake from April 30 to May 7 these interesting birds were common. Three were taken 4 miles west of Hornbeak on May 1 and 3, and they were seen at Samburg, Ridgely, and Union City. One was observed 6 miles west of Waynesboro on May 9.

CARPODACUS PURPUREUS PURPUREUS (Gmelin): Eastern Purple Finch

Found only in spring migration in the western part of the State, where specimens were taken at Frayser, April 8, and near Hickory Withe, April 9 and 14. There is an old specimen in the collection taken at Rockwood, March 28, 1885, by W. H. Fox.

SPINUS PINUS PINUS (Wilson): Northern Pine Siskin

One of the surprises in the present collection is a pine siskin taken on July 2 at 2,700 feet elevation, 4 miles southeast of Cosby in the Great Smoky Mountains. The bird is a young female barely grown and must have been reared at some nearby point. Several were found mixed with goldfinches on July 2 and 3. As this report was going to the printer, Ganier and Clebsch [53] reported the siskin from Clingmans Dome in June 1938.

SPINUS TRISTIS TRISTIS (Linnaeus): Eastern Goldfinch

Recorded as follows: Hickory Withe, April 15; Reelfoot Lake, April 27; Waynesboro, May 17; Rockwood, March 14, 1885, and April 19, 1884 (W. H. Fox); Shady Valley, June 11; Great Smoky Mountains, near Cosby, June 19, and at White Rock (5,000 feet elevation), July 1.

PIPILO ERYTHROPHTHALMUS ERYTHROPHTHALMUS (Linnaeus): Red-eyed Towhee

The distribution of the towhees of Tennessee is somewhat involved, as two forms are concerned with specimens from certain localities that are definitely intermediate between the two. After prolonged study of the series at hand it appears that true *erythrophthalmus* may range in the breeding season in the western part of the State west of

[53] Migrant, 1938, p. 42.

Wayne County, and from there across the north. Migrants of this race occur all through Tennessee.

Specimens taken at Frayser, April 8, and near Hickory Withe, April 12 and 15, are representatives of the northern bird and are assumed to be breeding individuals. A series of five from the Holston Mountains adjacent to Shady Valley, secured on June 2, 3, and 12, all have the darker sides and large white area on the outer rectrix characteristic of the northern race. The elevations at which these birds were collected range from 2,800 to 3,300 feet. Two birds from the center of the valley, however, are *canaster*. A series secured by W. H. Fox near Rockwood is somewhat confusing, since birds that may be assigned to both races are included. Five taken on March 16 and April 7, 8, 14, and 15 are referable to true *erythrophthalmus*. They may come from a different elevation than one other that I consider *canaster*. Though part may be migrants, it seems probable that part are breeding birds. This may be an area of intergradation.

Other specimens, taken in fall where they may have been migrant from the north, include birds from the following localities: Tiptonville, October 20; Samburg, October 14; Dover, October 25; Pulaski, November 1 and 2; and Frankewing, November 4.

PIPILO ERYTHROPHTHALMUS CANASTER Howell: Alabama Towhee

As indicated above, the ranges of the two forms of towhee found in Tennessee can be determined only in general from the material at hand. It appears that the Alabama towhee, *P. e. canaster*, is found from Wayne County eastward throughout the southern section of the State, its area increasing to the northward as the eastern border is approached. Two males taken on May 10 and 15 at points 8 and 10 miles north of Waynesboro fall within the limits of *canaster* in color of sides and in the extent of the white on the outer rectrix, this measuring 33.0 and 34.5 mm (the latter bird tending to be intermediate but nearer *erythrophthalmus*). Another taken 8 miles north of Waynesboro on May 15, with the tail spot 32.9 mm, has the sides appreciably darker than the other two and is more definitely an intermediate individual. An immature male shot 6 miles east of Pulaski on November 4 is typical of the Alabama form. (Two specimens of *erythrophthalmus* from this same region taken in November may be northern migrants.) A male from 9 miles southeast of Spencer in Van Buren County, May 21, is *canaster*, as are three from Birds Creek 7 miles southwest of Crossville. A male taken by W. H. Fox near Rockwood on April 1, 1885, has the tail spot only 28.6 mm long and is considered intermediate because of the darker color of the sides. Three others from near this same point seem typical of *erythrophthalmus*, indicating that the line of intergradation is near.

A male and a female shot near Beaverdam Creek in the valley bottom at Shady Valley on June 5 and 10 are *canaster*, though birds from low in the Holston Mountains a few miles west are referred to *erythrophthalmus*. This is the farthest north and east that *canaster* is recorded. An immature female taken on September 18 at 5,900 feet elevation on Roan Mountain has the tail spot only 27.2 mm, though the flanks are dark. It is considered intermediate but nearer *canaster*. This may be an area of intergradation. Two from the Great Smoky Mountains, a male taken on June 19 at 5,000 feet on Cosby Knob and a female on June 29 at 6,100 feet on Old Black Mountain, are both *canaster*. These two indicate that the southern form extends through these mountains and on to the south.

PASSERCULUS SANDWICHENSIS SAVANNA (Wilson): Eastern Savannah Sparrow

Two eastern Savannah sparrows were taken at Bartlett on April 19, at the same time as one of the paler Churchill form. At Rockwood W. H. Fox secured specimens on March 18, 21, and 31 and April 7, 1885. These are all dark in general appearance, with the lighter edgings of the dorsal feathers distinctly brownish.

PASSERCULUS SANDWICHENSIS OBLITUS Peters and Griscom:[54] Churchill Savannah Sparrow

Two females collected by Perrygo and Lingebach, at Ellendale on April 17 and near Bartlett on April 19, are marked by the pale gray margins and heavy black centers of the dorsal feathers, gray and black being the predominant colors, with little or no buff or brown. They are considered migrants of this race, which is recorded in the original description[55] from the Great Smoky Mountain region. The form is well marked and easily distinguished. The abundance of this subspecies and of the true Savannah sparrow in Tennessee has still to be ascertained.

In the paper containing the description of this new form, a treatment of geographical variation in the Savannah sparrow, the authors[56] list the Ipswich sparrow as *Passerculus sandwichensis princeps*, saying that "there is no *absolute* difference of any kind between this form and one or more races of *P. sandwichensis*. In size it is not only no larger than *P. s. sandwichensis*, but the smallest specimens are smaller than the largest specimens of *P. s. savanna*. The pallor of its coloration is not very marked when compared with *P. s. nevadensis*, and is exceeded by certain races of the *rostratus*

[54] *Passerculus sandwichensis oblitus* Peters and Griscom, Bull. Mus. Comp. Zoöl., vol. 80, Jan. 1938, p. 454 (Fort Churchill, Manitoba).
[55] *Ibid.*, pp. 456, 458.
[56] *Ibid.*, pp. 447–448.

group in Lower California." That *Passerculus princeps* is closely related to the Savannah sparrows is easily evident. It is also evident that it is very distinct from those forms of the Savannah sparrow *labradorius* and *savanna* with which it may associate (*oblitus* possibly included on rare occasions on the southeastern coast). If we concede *princeps* position as a subspecies of *Passerculus sandwichensis* by linkage through forms now and probably for all past time geographically remote, then we arrive at a difficult situation.

It is common in a genus of birds for certain characters of pattern or color to be repeated in different racial groups. Thus a spotted shoulder is common among pigeons of the *Columba* group (using this name in a broad sense), or a patch pattern, where black and white, or their combination, gray, occurs in varying arrangements, is found in the stilts of the genus *Himantopus*. To me it does not appear proper to consider such resemblances in groups of individuals geographically remote from one another, where there is no definite indication of earlier direct connection through which intergradation might occur, as denoting subspecific relationship. Such resemblances are of a generic rather than of a subspecific nature.

It appears to me therefore that *Passerculus princeps* should be retained as a species distinct from *sandwichensis* and its races and that resemblances between it and far distant races of *sandwichensis* are to be ascribed to convergence, and not to that closer genetic relation that must be held to exist between nearly allied subspecies. The range and ecological preference of *princeps* are so restricted as to give definite support to its separation as a distinct group. If we are to accept the other line of reasoning proposed, then we might be under necessity of recognizing with similar nomenclatural treatment far more remotely connected forms through relationships in remote ages; and if we were to follow such a line of reasoning far enough we might be brought to the situation of treating all existing birds as geographic races of one species through relationship in time and space! The problem tends to become complicated and to assume a highly hypothetical aspect.

AMMODRAMUS SAVANNARUM AUSTRALIS Maynard: Eastern Grasshopper Sparrow

Near Pikeville several were seen and three were taken on May 29 and 31. In Shady Valley they were fairly common, two being taken on June 9 and 15. At Rockwood W. H. Fox secured one on March 24 and another on April 18, 1885.

These birds all have the darker coloration of the eastern bird, though they are of the maximum size for that race. The western form may occur in migration in the western part of the State.

Measurements of the Tennessee specimens are as follows: Males (5 specimens), wing 60.0, 60.2, 61.8, 62.2, 63.7, tail 40.8, 41.3, 41.8, 45.4, 46.6, culmen from base 11.8, 12.6, 12.8, 13.0 (one imperfect), tarsus 19.2, 19.3, 19.6, 20.7, 20.8; females (2 specimens), wing 57.9, 58.9, tail 40.0, 43.8, culmen from base 12.6, 12.7, tarsus 19.1, 20.0 mm.

POOECETES GRAMINEUS GRAMINEUS (Gmelin): Eastern Vesper Sparrow

As a breeding bird the vesper sparrow was fairly common in Shady Valley from June 5 to 15, a male being taken on June 12. It is probable that birds collected at 5,500 feet elevation on Roan Mountain on September 13, 16, and 17 were local birds also. A male, assumed to be in migration, was taken 7 miles northeast of Tiptonville, October 20. Other specimens in the National Museum were collected by W. H. Fox at Chattanooga on March 13, 1882, Lookout Mountain on March 23, 1882, and Rockwood on March 6, 1885.

AIMOPHILA AESTIVALIS BACHMANII (Audubon): Bachman's Sparrow

The only specimens are a small series collected by W. H. Fox, including birds from Lookout Mountain, April 4, 1882, and from Rockwood, April 3, 1884, and April 14, 15, 17, 22, and 25, 1885.

That there are three geographic races of *Aimophila aestivalis* instead of the two currently recognized in the A. O. U. Check-list is evident on examination of the material in the U. S. National Museum. *A. a. aestivalis*, very dark brown above, with the feathers margined broadly with gray and streaked heavily with blackish, is restricted to southeastern Georgia and Florida. Birds from southwestern Indiana and southern Illinois to southern Mississippi and eastern Texas are much lighter, more rufescent-brown above, with black streakings usually entirely absent and where present much reduced. These are to be known as *Aimophila aestivalis illinoensis* (Ridgway).[57] As these lines were written Sutton [58] has identified as *illinoensis* specimens from McCurtain County, Okla., and Oberholser [59] has listed under this name birds from Louisiana.

A. a. bachmanii stands midway between these two, differing from *A. a. aestivalis* in being brighter, more rufescent, with the gray margins of the feathers less evident, and from *illinoensis* in being darker brown, with prominent blackish streaks on the back.

The birds from Tennessee, as might be expected, are definitely intermediate between *bachmanii* and *illinoensis*. One or two are closely

[57] *Peucaea illinoensis* Ridgway, Bull. Nuttall Orn. Club, 1879, p. 219 (Wabash County, Ill.).

[58] Auk, 1938, p. 508.

[59] Dept. Cons. State of Louisiana Bull. 28, 1938, p. 661.

similar to the latter, but the series averages slightly darker brown above and is marked by definite blackish streakings above (though these are much reduced in two specimens). They are identified as intermediate, but nearer to *bachmanii*. True *illinoensis* should occur in western Tennessee at least in migration.

JUNCO HYEMALIS HYEMALIS (Linnaeus): Slate-colored Junco

Represented by specimens as follows: Hickory Withe, April 15; Tiptonville, October 22; Dover, October 25; Frankewing, November 9; Lookout Mountain, March 20, 1882 (W. H. Fox); Rockwood, March 2, 13, and 21, 1885, and April 7, 1884 (W. H. Fox).

JUNCO HYEMALIS CAROLINENSIS Brewster: Carolina Junco

Juncos were fairly common in the mountains bordering Shady Valley, specimens being taken at 3,800 to 4,000 feet in the Iron Mountains on June 6 and 14 (the latter a bird in juvenal plumage) and at 3,800 feet in the Holston Mountains on June 4. On Roan Mountain skins were secured at 6,200 feet on September 22. One is partially albinistic on the throat. In the Great Smoky Mountains the Carolina junco was very common. Specimens were taken at 5,000 feet on Cosby Knob June 19, at 6,300 feet on Old Black Mountain on June 21, and at 6,600 feet on Mount Guyot on June 21 and 24. Others were seen at 5,000 feet and above on Inadu Knob, Camels Hump, and White Rock. On July 10 a junco was recorded at 4,100 feet on Big Frog Mountain.

SPIZELLA PASSERINA PASSERINA (Bechstein): Eastern Chipping Sparrow

The familiar chipping sparrow is common in Tennessee, being represented as follows: Hickory Withe, April 15; Dover, October 25; Waynesboro, May 11 and 14; Melvine, May 21; Pikeville, May 31; Crossville, May 27; Rockwood, March 9 and April 1, 1885 (W. H. Fox); Shady Valley, June 10 and 11; and at 2,700 feet elevation near Cosby in the Great Smoky Mountains, June 20 and 29.

SPIZELLA PUSILLA PUSILLA (Wilson): Eastern Field Sparrow

A common sparrow that as a breeding bird covers the State except in the extreme western portion. Records attributed to true *pusilla* are as follows: 4 miles west of Hornbeak, May 3; 10 miles east of Pulaski, November 2 and 3; Chattanooga, March 15, 1882 (W. H. Fox); Rockwood, March 4, 18, and 28, 1885, April 3, 6, and 8, 1884 (W. H. Fox); Shady Valley, June 3; 2,700 feet elevation, 4 miles southeast of Cosby, Great Smoky Mountains, June 30. A bird from

Waynesboro taken on May 14 is somewhat intermediate toward *arenacea* but is decidedly nearer to *pusilla*.

SPIZELLA PUSILLA ARENACEA Chadbourne: Western Field Sparrow

There are three specimens in the collection that may be ascribed to this race, a female taken at Hickory Withe, April 15, and two immature birds, male and female, from 7 miles northeast of Tiptonville taken on October 22. The two last are probably migrants, as a male taken near Hornbeak on May 3 is the eastern form. It will be recalled that a female from near Waynesboro while identified as the eastern form is somewhat intermediate.

The identification of these western Tennessee specimens has come as the result of speculation and study as to the identity of the western field sparrow that began more than 30 years ago with skins that I obtained in southeastern Kansas. In brief summary, *Spizella pusilla arenacea* is marked by the very pale brown of the markings of the upper surface, gray predominating, with little or no bright chestnut, the restriction of the brown on the crown which usually has a gray median band, the light margins on the secondaries, the narrowed black lines on the back, and the grayish white on the lower surface, which has a suffusion of buffy brown on the breast in fall and winter only. This type of coloration finds its highest expression in the Great Plains area in birds from such widely separated localities as Medora, N. Dak., Fort Pierre, S. Dak., and San Angelo, Tex., in which the crown in summer is largely or almost wholly gray. These Great Plains specimens have the wing, tail, and tarsus actually, as well as on the average, very slightly longer than specimens from the East. Measurements are as follows: Males (10 specimens), wing 67–70, tail 65–72, tarsus 17.5–21.1; females (2 specimens), wing 60.5–64.0, tail 62.2–63.0, tarsus 17.7–17.8 mm.

Spizella pusilla pusilla is extensively brown above, with bright brown predominating in the coloration of the upper surface, the black streakings of the back broad and heavy, the lighter areas on rump and shoulder darker in tone, ordinarily brownish gray, the margins on the secondaries darker, more rufescent, and a suffusion of pinkish buff on the breast that is indicated even in worn breeding plumage. Measurements are as follows: Males, wing 59.7–65, tail 58–65, tarsus 17.2–18.5; females, wing 59.4–62.7, tail 54.3–62.2, tarsus 17.2–18.2 mm. (These measurements are in part those made for Mr. Ridgway and in part from specimens measured recently for or by me.) Birds of this type of coloration and with these dimensions are found from southern Quebec to the Carolinas and west to Ohio, West Virginia, central Tennessee, and Mississippi.

There remains between the two ranges indicated an area of considerable extent, reaching in general from the region near the Mississippi River to eastern Texas, eastern Kansas, and northward (I do not have material at hand from the section north of Kansas), in which the field sparrows have the slightly smaller size found in typical *pusilla* of the East but are definitely paler and grayer than that bird. Some are almost as gray above and below as typical *arenacea*. The majority are somewhat browner, the brown being dull, however, with gray predominating, the black streakings reduced, and the light margins on the secondaries paler. They are distinctly intermediate between the two races and are variable between the two in their color characters. In the eastern section of this area of intergradation individual birds may verge toward the paler group, or they may be reddish like true *pusilla*. This condition is found in two skins from Waterloo, Mich., in which a male taken on April 30 is definitely reddish brown, and a female collected on April 16 is distinctly grayer, though of the *pusilla* type. Specimens from Mount Carmel, Ill., Wheatland, Ind., and western Kentucky are of the true *pusilla* type, verging only slightly toward the grayer tone of birds of farther west.

After somewhat prolonged consideration it appears to me, and to some others who have examined the problem with me, that we have here the ideal condition as regards the concept of subspecific groups in a species of considerable range. The two races of *Spizella pusilla* occupy definite geographic areas with a region of intergradation as they approach. To put the majority of the intergrades with the western form is to place greater emphasis on color than on size, which seems proper, as the size differences separating *arenacea* from *pusilla* are minor and the color differences considerable. Color, therefore, is more important than size. To give the series of intermediates a separate name would serve in my opinion only to complicate the picture, with no useful result because of the definitely mixed character of the population concerned.

ZONOTRICHIA LEUCOPHRYS LEUCOPHRYS (Forster): White-crowned Sparrow

Specimens were collected near Hornbeak, April 28; near Reelfoot Lake 7 miles northeast of Tiptonville, October 22; and on the Cumberland River near Indian Mound, October 27.

ZONOTRICHIA ALBICOLLIS (Gmelin): White-throated Sparrow

An abundant bird at all localities worked at the proper seasons. Records are as follows: Hickory Withe, April 9, 10, and 13; Reelfoot Lake, April 24 and 26; Hornbeak, May 4; Reelfoot Lake, 4 miles south of Samburg, October 13; Dover, October 25 and 26; Waynesboro, May

10 and 11; Pulaski, November 1 and 3; Frankewing, November 4; Rockwood, March 20 and April 1, 1884, and April 16, 1885 (by W. H. Fox). The first noted in fall by Perrygo were seen near Reelfoot Lake, 2 miles east of Phillippy, on October 12.

PASSERELLA ILIACA ILIACA (Merrem): Eastern Fox Sparrow

The fox sparrow was taken at Reelfoot Lake near Tiptonville, October 18, and on the Cumberland River, 2 miles west of Indian Mound, October 27. There is one in the collection taken at Rockwood, March 18, 1885, by W. H. Fox.

MELOSPIZA LINCOLNII LINCOLNII (Audubon): Lincoln's Sparrow

This shy migrant was collected at Reelfoot Lake, April 29 and 30 and October 23; near Hornbeak, May 3; on the Cumberland River 7 miles north of Dover, October 30; and near Waynesboro, May 13 and 17.

MELOSPIZA GEORGIANA (Latham): Swamp Sparrow

A common visitor recorded as follows: Hickory Withe, April 10 and 16; near Tiptonville, October 16; near Reelfoot Lake, 2 miles east of Phillippy, October 12 and 23; on the Cumberland River, near Dover, October 26; near Pulaski, November 4; near Frankewing, November 4; Rockwood, March 19, 20, and 23, 1885 (W. H. Fox).

MELOSPIZA MELODIA MELODIA (Wilson): Eastern Song Sparrow

Present in the State as a migrant, apparently in small numbers. Perrygo obtained his first specimen ascribed to this race on Clinch River, 6 miles northwest of Bean Station, on October 2. Two others were taken on the Cumberland River near Dover, on October 26, and another 6 miles east of Pulaski on November 4. These four are distinctly lighter, and have less distinct dark dorsal markings than *M. m. euphonia* obtained at the same season of the year, but are slightly grayer than the average of typical *M. m. melodia.* They are, however, to be ascribed to *melodia.*

MELOSPIZA MELODIA EUPHONIA Wetmore: Mississippi Song Sparrow

This is the common form of song sparrow of Tennessee according to present information. In Shady Valley, along Beaverdam Creek, it was a common breeding bird from June 2 to 15, specimens taken being typical in dark coloration and heavy black dorsal streaks. I collected a set of five nearly fresh eggs here on June 7, the nest being a cup of grasses and other herbaceous material placed on the

ground in a clump of grass. The ground color is pale greenish white, marked heavily with russet, which occurs in small dots or patches and large blotches, in the main obscuring the lighter background. One egg is broken. The other four measure as follows: 19.4 by 15.5, 19.4 by 15.6, 19.4 by 15.7, and 19.6 by 15.3 mm.

Several song sparrows were seen in the valley near Carter on June 7, and Perrygo observed one on June 19 and another on June 22 about 4 miles southeast of Cosby in the Great Smoky Mountains. On Roan Mountain at 5,900 to 6,200 feet song sparrows were fairly common from September 11 to 18. The five taken are all immature birds, one being mainly in juvenal plumage, two in heavy molt from this dress, and two in nearly complete fall dress. These are believed to be resident birds in this area.

Birds taken in migration season include the following: 7 miles northeast of Tiptonville, October 22; Reelfoot Lake, 2 miles east of Phillippy, October 23; Cumberland River near Dover, October 26; and 10 miles east of Pulaski, November 4. There are also in the Museum skins taken by W. H. Fox at Lookout Mountain, March 21, 1882, Chattanooga, March 13, 1882, and Rockwood, March 4, 13, and 23, 1885.

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ANNOTATED LIST OF TENNESSEE MAMMALS

By Remington Kellogg

During 1937 the United States National Museum conducted natural-history field work in Tennessee, for the purpose of making a collection of birds and mammals of the State. Watson M. Perrygo was in charge of the field party, with Carleton Lingebach and Henry R. Schaefer acting as field assistants. Leaving Washington on April 3, Perrygo and Lingebach traveled across Virginia and Tennessee to Ellendale, Shelby County, where they established their first camp on April 7. From this camp they collected at several localities in Shelby and Fayette Counties until April 22. They worked in the vicinity of Reelfoot Lake, Obion County, from April 23 to May 9; in Wayne County from May 9 to 20; and in Cumberland County from May 20 to June 1. The party then commenced field work in the eastern mountainous section, where with Shady Valley as a base camp they made collections in this valley and in the Holston Mountains from June 2 to 16. Moving camp to Cosby, in Cocke County, they worked in the Great Smoky Mountains from June 18 to July 5. After working in the vicinity of Big Frog Mountain, Cherokee National Forest, from July 8 to 15, they discontinued field operations for a few weeks and returned to Washington on July 17.

On September 9 Perrygo and Schaefer left Washington and drove to Roan Mountain, where they worked from September 11 to 25. They collected in the Clinch Mountains and elsewhere in Grainger County from September 27 to October 2, and around Reelfoot Lake from October 4 to 24. They worked in Stewart County from October 25 to 30 and in Giles and Lincoln Counties from November 1 to 10, when the season's work was concluded.

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The present paper reports not only on the mammals collected during the course of the field work in Tennessee conducted in 1937 but also on all the Tennessee specimens in the National Museum and the Biological Survey collections. The collectors of the specimens herein discussed are listed as follows chronologically according to the year in which the material was obtained:

U. S. National Museum

Richard Owen, 1854.
J. B. Mitchell, 1856.
John Constable, 1877.
James W. Rogan, 1884.
C. S. Brimley, 1891.
H. H. Brimley, 1891.
William Palmer, 1897.
W. P. Hay, 1902.
Paul Bartsch, 1907.
Porter Dunlap, 1911.
Robert Gorham, 1911.
Clarence B. Moore, 1914, 1915, 1916.
Lloyd Branson, 1915.
J. D. Ives, 1925, 1926.
J. G. Gillespie, 1927.
R. J. Fleetwood, 1934.
Carleton Lingebach, 1937.
Watson M. Perrygo, 1937.
Henry R. Schaefer, 1937.
A. R. Cahn, 1938.

U. S. Biological Survey

T. J. Park, 1891.
G. A. Coleman, 1892.
Russell J. Thompson, 1892.
H. C. Oberholser, 1895.
Charles R. Ellis, 1904.
Stanley E. Piper, 1904.
Arthur H. Howell, 1908, 1910, 1930.
W. H. Provins, 1908.
W. J. Millsaps, 1909, 1910.
Adam G. Millsaps, 1912.
Morton L. Church, 1912.
Earl May, 1931.
James Silver, 1933.
R. J. Fleetwood, 1934.

Measurements herein are given in millimeters.

The birds collected in the Tennessee field work have been reported on by Dr. Alexander Wetmore.[1]

Family DIDELPHIIDAE

DIDELPHIS VIRGINIANA VIRGINIANA Kerr: Opossum

The opossum seems to be distributed over the whole State, occurring most frequently in the timbered bottomlands and in the rock ledges on the bluffs bordering the stream valleys. In the mountainous sections of eastern Tennessee, the vertical range of the opossum goes at least to 3,700 feet. Perrygo and Schaefer were told in September 1937 that opossums were common in valleys northwest of Roan Mountain.

S. C. Williams relates (1924, p. 217) that Senator Hugh Lawson White of Tennessee, in replying to a speech by Senator Webster, referred to the abundance of opossums in the short-lived State of Franklin. He stated that about 1785 the subtreasurers or collectors took in peltries for taxes, as provided by law. Although raccoon

[1] Proc. U. S. Nat. Mus., vol. 86, no. 3050.

skins were readily procured, opossum skins that had little or no value were even more plentiful. The collectors obtained the requisite number of opossum skins, cut the tails off the raccoon skins and sewed them to the opossum skins, and then deposited them in the general treasury. The raccoon skins were sold by the collectors to the hatters.

During the spring of 1937 it was reported that opossums were not so abundant as formerly in Shelby and Fayette Counties. One that had been run over by an automobile was seen on April 13, 1937, on the road near Memphis. On April 23, 1937, in Obion County, one was seen crushed on the road near Hornbeak, and the following day on the road between Troy and Reelfoot Lake three crushed opossums were noted. Rhoads (1896, p. 176) did not collect opossums in Tennessee, but he was told by B. C. Miles that the Negroes of Haywood and Lauderdale Counties claimed there were two kinds, one with black and the other with white feet.

On May 11, 1937, another crushed opossum was seen on the road 11 miles north of Waynesboro, Wayne County. On November 8, 1937, a female opossum was taken near Frankewing in a Schuyler trap set for flying squirrels. Fourteen embryos, the largest of which have a head and body length of 60 mm, were removed by Russell J. Thompson from the pouch of a female collected on June 23, 1892, at Big Sandy. The measurements of the largest male (U.S.N.M. no. 46895, Danville) in this series of 11 Tennessee specimens are as follows: Total length, 785; tail, 320; hind foot, 52.

Specimens taken at Greenbrier, Sevier County, are listed by Komarek and Komarek (1938, p. 145).

Benton County: Big Sandy, 1.
Carter County: Carvers Gap, Roan Mountain, altitude 3,700 feet, 1.
Grainger County: Thorn Hill, Clinch Mountains, altitude 1,800 feet, 2.
Houston County: Danville, 1.
Humphreys County: South of Johnsonville, 1.
Lincoln County: 6 miles east Frankewing, 1.
Montgomery County: Clarksville, 3.
Sumner County: Rockland [Hendersonville P. O.], 1.

Family TALPIDAE

PARASCALOPS BREWERI (Bachman): Hairy-tailed Mole

Hairy-tailed moles were reported to be common in cultivated fields in the vicinity of Shady Valley. A female was trapped by W. M. Perrygo and Carleton Lingebach on June 13, 1937, in a cornfield near a bog. Komarek and Komarek (1938, p. 145) report that hairy-tailed moles were trapped in damp rhododendron thickets in Sevier County along Chapman Prong (altitude 3,200 feet) and Buck Fork of Little Pigeon River.

Johnson County: Shady Valley, altitude 2,900 feet, 1.

SCALOPUS AQUATICUS AQUATICUS (Linnaeus): Eastern Mole

The range of this race seems to be restricted to the drainage basins of the upper Tennessee—Clinch, Holston, and French Broad Rivers in the eastern part of the State. Howell (1909, p. 67) states that this mole was reported to occur in the vicinity of Briceville, Anderson County, and that it was scarce on Walden Ridge near Soddy, Hamilton County. On the western slope of Low Gap, two moles were trapped in an old cornfield. The male (U.S.N.M. no. 267145) from Low Gap has a somewhat shorter skull than average individuals of the race from Virginia and Maryland, although the well-worn teeth show that it is fully adult. It is, however, approximately the same size as a skull (U.S.N.M. no. 99639) from Falls Church, Va., which has similarly worn teeth. This mole has been recorded from Dry Valley, Blount County (Komarek and Komarek, 1938, p. 145).

Blount County: 1.
Cocke County: Low Gap, 4½ miles southeast of Cosby, altitude 2,700 feet, 2.
Hamilton County: Walden Ridge near Rathburn [Soddy P. O.], 1.

SCALOPUS AQUATICUS MACHRINUS (Rafinesque): Prairie Mole

This mole occurs in the bluegrass region of middle Tennessee, chiefly in the lower drainage areas of the Big Sandy, Tennessee, and Cumberland Rivers, as well as in the bottomlands bordering the small tributaries of the Mississippi River. Jackson (1915, p. 44) lists three specimens from Nashville, Davidson County.

From Benjamin C. Miles, Rhoads (1896, p. 201) received information that the mole is common in Haywood County "wherever land is rich, and is troublesome in that he burrows in the rows and destroys growing plants, and runs tunnels up and down hill which I have seen in one season wash into gullies 18 inches deep."

Four moles taken by W. M. Perrygo and Carleton Lingebach during April 1937 extend the range of this race to the southwestern corner of the State. These moles were trapped in a cottonfield and, judged from the number of runways, moles were apparently common in northwestern Shelby County. The four specimens from Shelby County resemble *machrinus* in general coloration, but they have shorter skulls and slightly lighter dentition, as well as a shorter total length. These specimens approach individuals of *howelli* from Ardell (U.S.N.M. no. 207227) and Greensboro (U.S.N.M. no. 57050), Ala., in the length of the skull and size of the teeth, but differ in coloration. The above-mentioned specimens of *howelli* are considerably larger than topotypes. Burrows made by moles were seen along the edge of the cypress swamp near Hickory Withe, but the museum party did not succeed in trapping any.

Benton County: Big Sandy, 1.
Humphreys County: South of Johnsonville, 1.
Montgomery County: Clarksville, 1.
Shelby County: Ellendale, 4.
Sumner County: Bethpage, 1.

CONDYLURA CRISTATA (Linnaeus): Star-nosed Mole

On June 13, 1937, a desiccated mole was picked up by W. M. Perrygo and Carleton Lingebach at their camp on the edge of the rhododendron bog at Shady Valley. Audubon and Bachman (1851, vol. 2, p. 142) refer to this mole's occurrence in the State as follows: "To the west we have traced it in Ohio and the northern parts of Tennessee."

Johnson County: Shady Valley, altitude 2,900 feet, 1.

Family SORICIDAE

SOREX CINEREUS CINEREUS Kerr: Cinereous, or Masked, Shrew

The range of this masked shrew in Tennessee seems to be restricted to the eastern mountainous portion of the State. Rhoads (1896, p. 202) writes that the burrows of this shrew "were found under decaying logs and large stones in moist places along the bridle path leading directly from Cloudland to the Doe River Valley," Carter County. Two were taken in September 1937, at an altitude of 6,200 feet in moss at the base of fir trees in the forest on the summit of Roan Mountain. Masked shrews were trapped by A. H. Howell in a spruce and fir forest near the summit of the ridge at Indian Gap. On the summit of Old Black Mountain, these shrews were caught in runways in damp moss at the base of fir trees. Masked shrews appear to be generally distributed throughout the wooded ridges of the Great Smoky Mountains National Park. They have been recorded from the Buck Fork of Little Pigeon River, Dry Sluice, and Mount Guyot in Sevier County by Komarek and Komarek (1938, p. 146).

In tabulating a series of 17 skulls from Roan Mountain, N. C., it was found that 14 have the third and fourth unicuspids subequal, 3 have the third unicuspid smaller than the fourth, and 1 has the fourth unicuspid larger than the third. In the case of 11 skulls from New York (8 from Montauk Point, Suffolk County, and 3 from Mountain View, Franklin County), 5 have the third and fourth unicuspids subequal and 6 have the fourth unicuspid larger than the third.

Carter County: Roan Mountain, altitude 6,200 feet, 1.
Cocke County: Old Black Mountain, Great Smoky Mountains, altitude 6,300 feet, 2.
Sevier County: Indian Gap, altitude 5,200 feet, 2.

SOREX LONGIROSTRIS LONGIROSTRIS Bachman: Bachman's Shrew

These minute shrews are rarely taken by collectors. One was found by Raymond J. Fleetwood in a posthole in a field overgrown with sedgegrass at Greenbrier, Sevier County. Komarek and Komarek (1938, p. 146) mention another that had been trapped in one of the buildings of a C. C. C. camp in the Great Smoky Mountains National Park. The Sevier County occurrence indicates that this species may range northward in the valleys of eastern Tennessee. The taking of one of these small shrews by Perrygo and Schaefer near Reelfoot Lake on October 1, 1937, extends the range across the State to the Mississippi bottomlands. This male was trapped barely above the water line in matted decayed leaves beside a rotten log in the swamp bordering Reelfoot Lake.

The identification of these two specimens from Tennessee has led to a restudy of specimens previously referred to *Sorex fontinalis* and *Sorex longirostris longirostris*. It so happened that the specimens from southern localities available to Hollister (1911, pp. 378–380) had the third upper unicuspid smaller than the fourth. The larger series of specimens now available exhibits so many exceptions that I am unable to accept the conclusions of Jackson in regard to the distinctness of these two shrews. The characters listed by Jackson (1928, pp. 37, 83) as distinguishing *S. longirostris* from *S. fontinalis*, including (1) relatively shorter, broader rostrum, (2) shorter and more crowded unicuspid row, (3) third upper unicuspid smaller than fourth, (4) anteroposterior diameter less than transverse diameter of unicuspid teeth, (5) anteroposterior diameter of molariform teeth relatively greater, and (6) first incisors, upper and lower, relatively smaller, do not appear to me so to differentiate a series of 20 specimens. This series comprises 10 Maryland specimens previously referred to *S. fontinalis*, collected at Bowie, Cabin John, Cold Spring Swamp, Glen Echo Heights, Hollywood, Hyattsville, Laurel (2), and Sandy Spring (2), and a like number of *S. longirostris* from Chesapeake Beach, Md., Falls Church, Va., Pisgah National Forest and Raleigh (2), N. C., Young Harris, Ga., Phillippy and Greenbrier (Sevier County), Tenn., and Bicknell, Ind. (2). After tabulating this series according to the relative sizes of the third and fourth unicuspids, it was found that this character cannot be relied on. The dimensions of the molariform teeth, the unicuspids, and the first incisors can be matched in several specimens in both groups. In one of the Tennessee specimens the anteroposterior diameter of the third molariform teeth is less than the transverse, and in the other these measurements are reversed. Micrometer measurements of the rostrum and of the teeth made with a binocular failed to differentiate readily specimens from the supposed range of *S. longirostris* from

those of *S. fontinalis*. A similar crowding of unicuspid teeth was observed in individuals in both series. Tabulations based on the above-mentioned characters indicate that they are so highly variable that not even a limited correlation with geographic distribution can be discerned. In the light of the present series of specimens it seems clear that the supposed distinctions between *Sorex longirostris* and *S. fontinalis* are nothing more than individual variations.

Lake County: Reelfoot Lake, 2 miles east of Phillippy, 1.
Sevier County: Greenbrier, 1.

SOREX FUMEUS FUMEUS Miller: Smoky Shrew

Smoky shrews in Tennessee are most frequently found in moist heavy spruce forests in the colder parts of the Transition and Canadian Zones. They were trapped in runways in the damp moss at base of balsam fir trees on the west slopes of Mount Guyot and Old Black Mountain. On the west slope of Inadu Knob, smoky shrews were caught in the moss on banks of a spring in a balsam-fir forest. They were likewise taken in moss on the west slope of Low Gap, 4½ miles southeast of Cosby. According to Komarek and Komarek (1938, p. 146), this shrew has been taken at the following localities in Sevier County: Chapman Prong and Eagle Rocks Prong of Little Pigeon River, Dry Sluice (near Mount Collins), and Little River (altitude 2,900 feet). A. H. Howell took one on August 21, 1908, near Highcliff in a damp heavily timbered ravine near the base of the north escarpment of Pine Mountain.

Campbell County: Highcliff, altitude 1,000 feet, 1.
Cocke County: Mount Guyot, Great Smoky Mountains, altitude 6,300 feet, 1; Old Black Mountain, Great Smoky Mountains, altitude 6,300 feet, 4; Inadu Knob, Great Smoky Mountains, altitude 5,700 feet, 2; Low Gap, 4½ miles southeast of Cosby, altitude 3,400 feet, 2.
Sevier County: Indian Gap, altitude 5,200 feet, 3.

CRYPTOTIS PARVA (Say): Small Short-tailed Shrew

Five of these little short-tailed shrews were taken during November 1937 by Perrygo and Schaefer in traps set in cotton-rat runways in thickly matted grass and broomsedge growing between the road and a small creek east of Pulaski. Four were trapped in *Microtus ochrogaster* runways during April and May 1937 in an abandoned alfalfa field on the edge of Reelfoot Lake. Three were trapped by A. H. Howell on one night, all within a few yards of one another, in prairie meadow mouse runways in a patch of dry grass and briers in an old field near Clarksville. Dr. A. R. Cahn submitted for identification a short-tailed shrew collected on October 18, 1937, at Norris, Anderson County.

These shrews were reported by Komarek and Komarek (1938, p. 147) as having been trapped in Sevier County in fallow fields overgrown with broomsedge at Greenbrier, along Fighting Creek near Gatlinburg, and in the runways of Stone's lemming mouse along Fish Camp Prong of Little River (altitude 2,730 feet).

Giles County: 6 miles east of Pulaski, 5.
Lake County: Reelfoot Lake, 3 miles north of Tiptonville, 4.
Montgomery County: Clarksville, 3.

BLARINA BREVICAUDA TALPOIDES (Gapper): Short-tailed Shrew

The short-tailed shrew is the largest of the five shrews recorded for the State. It lives in underground burrows and also makes surface runways under matted leaves and decaying vegetation. When hunting for food it frequently uses the runways of other small mammals. Blarinas were caught in the Great Smoky Mountains in large Schuyler traps that had been nailed to the trunks of trees 5 or 6 feet above ground.

At Shady Valley short-tailed shrews were trapped in a bog in which rhododendron and hemlock were growing. On the southeastern slope of Holston Mountain they were trapped along a small mountain stream in runways under moss in a growth of rhododendron and hemlock. On the west slope of Mount Guyot they were taken in a balsam-fir forest and at Low Gap in runways under moss in hemlock. On Snake Den Mountain, blarinas were trapped in runways under moss under mixed deciduous and hemlock trees growing on the banks of a swift-flowing mountain stream. The vertical range of this shrew extends to at least 6,300 feet. Komarek and Komarek (1938, p. 147) list specimens from the following localities in Sevier County: Fish Camp Prong of Little River, Grassy Patch (on Alum Cave Creek, 2 miles east of The Chimneys, altitude 4,000 feet), Greenbrier, Horsehoe Mountain (about 3 miles east of Mount LeConte and 1½ miles north of Mount Kephart), Silers Bald, and Walker Prong of Little River.

Specimens from eastern Tennessee average somewhat smaller than those taken in eastern and southern West Virginia, but they have a larger hind foot than those referred to *carolinensis*. Until this genus is revised, this series may be tentatively allocated to *talpoides*. From the eastern mountainous section the average measurements of 11 males are as follows: Total length, 115.6 (110–125); tail, 23.2 (19–27); hind foot, 14.7 (13–16). For 9 females from the same area the average measurements are: Total length, 117.2 (108–126); tail, 23.5 (16.5–27); hind foot, 15.1 (14–16.5).

Johnson County: Shady Valley, altitude 2,900 feet, 1; Holston Mountain, 4 miles northeast of Shady Valley, altitude 3,800 feet, 5; Holston Mountain, 3 miles northeast of Shady Valley, altitude 3,000 feet, 1.
Carter County: Roan Mountain, altitude 4,100–5,000 feet, 6.
Cocke County: Mount Guyot, altitude 6,300 feet, 1; Low Gap, 4½ miles southeast of Cosby, altitude 3,300–3,400 feet, 3; Snake Den Mountain, altitude 3,800 feet, 1.

BLARINA BREVICAUDA CAROLINENSIS (Bachman): Carolina Short-tailed Shrew, or Mole-shrew

Rhoads (1896, p. 202) found that the southern mole-shrew was present "in the bottom lands of west Tennessee both in the open and in deep swampy woods." He collected specimens at Samburg on the shore of Reelfoot Lake and in the bottom lands of Wolf River near Raleigh, Shelby County. Rhoads also lists specimens from Belleview in Davidson County, Sawyers Springs on Walden Ridge in Hamilton County, and Harriman in Roane County.

At Hickory Withe the National Museum party trapped these blarinas in runways under matted leaves on tussocks on cypress knees in the swamp as well as in the canebrake, at Frankewing under matted leaves alongside rotten logs in deciduous woods, and also on a dry hillside in deciduous woods 8 miles north of Waynesboro.

The short-tailed shrews collected in southern and western Tennessee average somewhat smaller than the eastern series. The average measurements of three males are as follows: Total length, 98.3 (85–112); tail, 19 (17–22); hind foot, 12.6 (11–14). For three females the average measurements are: Total length, 96.3 (85–109); tail, 19.6 (18–22); hind foot, 11.5 (11–12.5). These measurements correspond rather closely with those that are considered typical of the subspecies *carolinensis*. The average measurements of 15 males from localities in South Carolina, Georgia, and Alabama are as follows: Total length, 97.7 (94–110); tail, 18.8 (15–21); hind foot, 12 (11–13). For 10 females from the same States the average measurements are: Total length, 95 (86–103); tail, 19.9 (17–25); hind foot, 12 (11–13).

Benton County: Big Sandy, 1.
Davidson County: Nashville, 1.
Fayette County: Hickory Withe, 3.
Lincoln County: 6 miles east of Frankewing, 1.
Obion County: Samburg, 1.
Wayne County: 8 miles east of Waynesboro, 2.

Family VESPERTILIONIDAE

MYOTIS GRISESCENS Howell: Gray, or Howell's, Bat

Several thousand of these bats were found by Mohr (1933, pp. 50–51) during June 1932, hanging in compact masses from the roof

of a small chamber leading off from the main portion of Indian Cave. When the bats were disturbed, Mohr observed that hundreds flew around in the chamber and that probably only 5 percent carried their young, most of the females leaving their young hanging to the roof. The youngest of the bats were naked, and the oldest were about 3 weeks old. Mohr estimated that less than 10 percent of the bats were mature males. All the bats collected were in the russet phase. The Museum series from this cave was collected May 23, 1925, by Prof. J. D. Ives.

During June Mohr likewise found great numbers of these bats lining the roof of Nickajack Cave. When Mohr (1932, pp. 272–273) visited this cave on December 24, 1931, he found only a solitary female in the russet phase. On returning again to the cave on January 4, 1932, he located three males in the dusky phase. Arthur H. Howell collected a large series of these bats at Nickajack Cave on August 31, 1908. Under the name of *Myotis velifer*, Hahn (1908, p. 580) listed this bat as occurring in Nickajack Cave.

Grainger County: Indian Cave, on Holston River north of New Market, 15.
Marion County: Nickajack Cave, near Shell Mound, 76.

MYOTIS KEENII SEPTENTRIONALIS (Trouessart): Trouessart's Bat

On July 2, 1892, Russell J. Thompson found three of these bats hanging to rocks in Bellamys Cave, 4 miles from the Cumberland River. Miller and Allen (1928, p. 106) list two specimens from Hickman County.

Montgomery County: Bellamys Cave, 3.

MYOTIS LUCIFUGUS LUCIFUGUS (LeConte): Little Brown Bat

Rhoads (1896, p. 203) mentions four little brown bats collected by J. T. Park at Warner, Hickman County. Two specimens from Greenbrier, Sevier County, are listed by Komarek and Komarek (1938, p. 148).

MYOTIS SODALIS Miller and Allen: Indiana Bat

About 300 yards from the entrance of Nickajack Cave, Mohr (1932, pp. 272–273) on December 24, 1931, found a colony of about 300 Indiana bats hanging from the ceiling of a low chamber. On the far side of the stream in this cave Mohr found four additional clusters of these bats, each comprising several hundred individuals. On a second visit, January 4, 1932, Mohr estimated that there were 1,200 to 1,500 bats hibernating in this cave. The clusters contained individuals of both sexes. Not a single specimen of this bat was located when Mohr (1933, p. 51) revisited Nickajack Cave during June 1932.

Dr. A. R. Cahn submitted for identification two of these bats that were collected during April 1937 in Ward Cave, Bedford County. Arthur Stupka, park naturalist, Great Smoky Mountains National Park, submitted for identification a male taken on September 2, 1937, at Keener House, Sevier County (altitude 1,500 feet).

Marion County: Nickajack Cave, near Shell Mound, 1.

MYOTIS SUBULATUS LEIBII (Audubon and Bachman): Leib's Bat

This bat may occur in Tennessee, since it has been recorded on the north from White Sulphur Springs, W. Va., and Hickmans Cave, Ky.

LASIONYCTERIS NOCTIVAGANS (LeConte): Silver-haired Bat

Rhoads (1896, p. 205) tentatively identified as this species bats seen at Sawyers Springs on Walden Ridge, Hamilton County, and on Roan Mountain. It was Rhoads' belief that "the fluttering, moth-like flight of some of these mountain bats was characteristic of the peculiar movements of *noctivagans*." Two specimens from Cades Cove, Blount County, and one from Greenbrier, Sevier County, are listed by Komarek and Komarek (1938, p. 148).

PIPISTRELLUS SUBFLAVUS SUBFLAVUS (F. Cuvier): Southern Pipistrelle, or Georgian Bat

The southern pipistrelle is one of the most widely distributed bats in the State. It is found hibernating in caves during winter, and in summer it spends the day in rook crevices and the like. Near dusk and later in the evening during the summer months it may be recognized by its erratic, butterflylike flight over fields, in clearings in the woods, and near ponds. The two collected at Low Gap were shot in the evening of July 5, 1937, while flying around abandoned buildings of a Civilian Conservation Corps camp. On December 24, 1931, Mohr (1932, p. 272) observed a few of these bats about 300 yards from the entrance of Nickajack Cave. Prof. J. D. Ives collected for the Museum a few individuals during December 1925 in Indian and Nickajack Caves. Dr. A. R. Cahn submitted for identification five pipistrelles collected during April 1937 in Ward Cave, Bedford County, and another lot of ten that were captured on February 10, 1938, in a cave near Dry Creek, Hardin County. Arthur Stupka, park naturalist, Great Smoky Mountains National Park, submitted for identification five males taken during July 1937 in Saltpeter Cave, Blount County (altitude 1,750 feet). Komarek and Komarek (1938, p. 148) record a specimen from Greenbrier, Sevier County.

Anderson County: Briceville, 6.
Benton County: Big Sandy, 9.

Cocke County: Low Gap, 4½ miles southeast of Cosby, altitude 2,700 feet, 2.
Grainger County: Indian Cave, on Holston River near New Market, 2.
Hamilton County: Rathburn (Soddy P. O.), 2.
Hickman County: 1.
Houston County: Danville, 5.
Jefferson County: Jefferson City, 2.
Marion County: Nickajack Cave, near Shell Mound, 1.
Shelby County: Arlington, 3.

EPTESICUS FUSCUS FUSCUS (Beauvois): Big Brown Bat

Rhoads (1896, p. 204) reports that the brown bat is found on the Cumberland Plateau but that none were seen on Roan Mountain. He lists three specimens from Vaughans Cave, Belleview, Davidson County. H. Allen (1893, p. 152) lists a specimen collected in 1856 by Prof. J. B. Mitchell in Roane County. Dr. A. R. Cahn submitted for identification a brown bat collected on July 30, 1937, in Hatmaker Cave, Anderson County; another taken on October 2, 1937, at Norris; and a third captured on February 10, 1938, in a cave near Dry Creek, Hardin County. A specimen taken at Greenbrier, Sevier County, is listed by Komarek and Komarek (1938, p. 148).

Hamilton County: Rathburn (Soddy P. O.), 1.

LASIURUS BOREALIS (Müller): Red Bat

The red bat is occasionally found in caves during winter, but in summer it is usually found during daylight hours hanging from the smaller limbs of trees in wooded tracts. G. A. Coleman shot red bats in the open woods near the Loosahatchie River and in a clearing along the creek near Big Sandy. Rhoads (1896, p. 203) observed a few red bats in the mountains of eastern Tennessee. H. Allen (1893, p. 152) lists a specimen, which cannot now be located, collected in 1854 by Prof. Richard Owen at Tyree Springs, Sumner County. Miller (1897, p. 108) lists a specimen from Alexandria, De Kalb County. This bat has been taken also at Cades Cove, Blount County, and at Greenbrier, Sevier County (Komarek and Komarek, 1938, p. 148).

Anderson County: Briceville, 2; Coal Creek, 1.
Benton County: Big Sandy, 11.
Cumberland County: 2 miles east of Crossville, altitude 2,000 feet, 1.
Houston County: Danville, 1.
Humphreys County: Waverly, 1.
Knox County: Knoxville, 1.
Marion County: Nickajack Cave, near Shell Mound, 1.
Montgomery County: Clarksville, 1.
Shelby County: Arlington, 2.

LASIURUS CINEREUS (Beauvois): Hoary Bat

Rhoads (1896, p. 203) concluded that the hoary bat "is likely to occur either as a migrant or resident anywhere east of the Cumberland Plateau."

NYCTICEIUS HUMERALIS (Rafinesque): Evening, or Rafinesque's, Bat

The recorded occurrences of this bat in the State are all west of the southern Allegheny Mountains. The evening bat begins to hunt considerably before dark and may be recognized by its rather slow and steady flight. G. A. Coleman collected a number of individuals during June 1892 in an open space near the creek and along the railroad tracks at Big Sandy, as well as in the open woods near Arlington. Rhoads (1896, p. 204) refers to specimens of this bat taken in Hickman County by J. T. Park during August and September.

Benton County: Big Sandy, 14.
Hickman County: Warner, 1; Hickman County: 1.
Houston County: Danville, 1.
Shelby County: Arlington, 4.

CORYNORHINUS MACROTIS (LeConte): LeConte's Lump-nosed, or Big-eared, Bat

Arthur Stupka, park naturalist, Great Smoky Mountains National Park, lent eight specimens from Cades Cove, 14½ miles southeast of Maryville, Blount County (altitude 1,750 feet). Of these one was a female collected at Cades Cove on September 12, 1936, and the remainder, four males and three females, were taken at the Cades Cove C. C. C. camp schoolhouse on July 12–15, 1937. This bat has been taken also in Sevier County at Gatlinburg and Greenbrier (Komarek and Komarek, 1938, p. 148).

The lump-nosed bat may occur in middle Tennessee, since it has been recorded by Howell (1921, p. 28) near the northern boundary line of Alabama at Huntsville, Madison County, and by Miller (1897, p. 52) at Bowling Green, Warren County, Ky.

Family URSIDAE

URSUS AMERICANUS AMERICANUS Pallas: Black Bear

Black bears appear to have ranged over all Tennessee in early times, but they have since been exterminated in many sections. No skulls are available for examination, and this makes it impossible to say whether the Florida black bear (*Ursus floridanus*) formerly occurred in the southern parts of the State.

The Virginia trader Abraham Wood sent James Needham and Gabriell Arthur in 1673 to the Cherokee Indian town Cota, located

in what is now Monroe County, Tenn. While enroute to this place, Needham, as reported by Wood (Williams, 1928, p. 27), saw bears along the Holston River in the vicinity of Bays Mountains [? Hawkins County]. Dr. Thomas Walker (Williams, 1928, p. 172) relates that he had killed a male bear in Hawkins County on his trip in April 1750 to save his dog from further injury. In the valley of Boones Creek, a tributary of the Watauga River, near the old stage road between Jonesboro, Washington County, and Blountville, Sullivan County, there stood for many years a beech tree on which Daniel Boone in 1760 carved a notice that he had killed a bear there (Ramsey, 1853, p. 67). Lt. Henry Timberlake, on his trip down the Holston River during December 1761 from Kingsport, Sullivan County, to a large cave below the present site of Three Springs Ford, Hamblen County, commented on the amazing number of bears that he had seen (Williams, 1927, pp. 45, 47). The same traveler reported an abundance of bears in 1762 along the Little Tennessee River near the mouth of Tellico River (Williams, 1927, p. 71). Local residents reported that a bear was seen near Shady Valley, Johnson County, in 1936. Perrygo and Lingebach saw a black bear on June 25, 1937, and also on the following day at an altitude of 5,200 to 5,700 feet on Inadu Knob, Cocke County. Komarek and Komarek (1938, p. 148) report that a female and a large male black bear were taken above Greenbrier and another male along Ramsey Fort of Little Pigeon River in Sevier County. The visible bear "sign" noted by members of the field parties of the Chicago Academy of Sciences indicates that black bears are increasing in numbers since the establishment of the Great Smoky Mountains National Park.

Bears at one time were plentiful in the vicinity of the Cumberland settlements at Nashville, and many were killed for food by the early settlers. A hunter, Thomas Sharp Spencer, who was well known to the French and the Indians as the giant with "the big feet," hunted bears as early as 1775 a few miles southeast of Castalian Springs, Sumner County. Ramsey (1853, p. 450) states that a party of 20 hunters from Eatons Station [Nashville] traveled up the Cumberland River to the region between Caney Fork and Flynns Lick Creek [Smith, Putnam, and Jackson Counties], where they killed 105 bears during the winter of 1782. Putnam (1859, p. 296) writes that "bears and wolves were found in great numbers for a half-a-dozen years after the first settlements in the Harpeth Hills," 10 or 12 miles south of Nashville. During one winter Capt. John Rains "killed 32 bears within 7 miles of the Bluff, mostly in Harpeth Knobs, South of Nashville" (Putnam, 1859, p. 122). William Neelly, who had established a station for making salt at Neellys Bend of the Cumberland River, was killed by the Indians in 1788 on the night he

returned from a hunt for bear and buffalo meat for the workers (Putnam, 1859, p. 117). The records of Sumner County for 1787 show that "good fat bear meat" was accepted for taxes at 14 pence per pound, if delivered where troops were stationed (Putnam, 1859, p. 252).

Francis Baily (Williams, 1928, p. 407) mentions that while traveling the trail between Duck River and Nashville he heard bears and wolves howling on July 29, 1797. Andrew Michaux also records (Williams, 1928, p. 335) that bears were present in 1799 in the vicinity of Nashville. Abraham Steiner and Christian Frederic de Schweinitz wrote in their journal (Williams, 1928, pp. 504, 505, 519) that a bear was killed on November 24, 1799, near Drowning Creek and that John Binkley's party killed three bears the following day near Flat Rock [Cumberland County]. These two missionaries also mention that a Mr. Shaw, at whose cabin they stayed for one or two days, hunted bears in the vicinity of the Caney Fork road [Putnam County].

Black bears could be found without difficulty in 1881 in the mountains 15 or 20 miles from Chattanooga (Cee, 1881, p. 309). A few bears were reported in 1880 (Antler, p. 306) in the Caney Fork district, Van Buren County. Edward I. Mullins reported to me that a bear was seen about 1910 on his father's farm near Huntsville, Scott County, and that he had followed the tracks for a short distance. W. M. Perrygo was told by a local resident that a female and her cubs were killed in 1905 about 6 miles east of Waynesboro, Wayne County. This was the last bear seen in that vicinity. While collecting in Cumberland County, Perrygo was informed that a bear had been killed in 1921 near Crossville.

Black bears were plentiful for many years in the western part of the State. In his account of a voyage down the Mississippi River in 1700, Father James Gravier mentioned (Williams, 1928, p. 68) that "a quantity of bears" had been killed the preceding year at Fort Prud'homme [above Memphis]. While on his journey up the Mississippi River in 1723, Diron d'Artaguette camped a league above the second "Ecores à Prud'homme" [above Memphis, between the mouths of the Hatchie and Coal Creeks] where a "fat she bear of enormous size" was killed on March 23 (Williams, 1930, p. 10). Henry Rutherford and his guide, while surveying a large tract of land in 1785 on the south side of Forked Deer River, Lauderdale County, killed bears and other game for food (Williams, 1930, p. 44). David Crockett (1834, pp. 81, 92, 101), in relating his hunting experiences in the lowlands of Obion County, said that he killed bears in Obion County as early as 1822, and this county, longer than any other, remained a good hunting ground for bears and deer (Wil-

liams, 1930, p. 153). Crockett mentioned that in 1825 he killed four bears on one day and 105 in less than a year. During the year 1820, it is reported (Williams, 1930, p. 156) that Reuben Edmondson and John Bradshaw killed 85 bears in Weakley County. Benjamin Porter, Jr., born June 12, 1820, at Porters Gap, is said to have killed more than 100 bears in Lauderdale County during his lifetime (Williams, 1930, p. 161). From Benjamin C. Miles, Rhoads (1896, p. 199) learned that a bear killed in 1865 appeared to be the last record for Haywood County, though bears were occasionally killed in Lauderdale County as late as 1895.

Family PROCYONIDAE

PROCYON LOTOR VARIUS Nelson and Goldman: Alabama Raccoon

Although raccoons are still numerous in some districts in Tennessee, they were even more plentiful when the first settlers arrived. Lt. Henry Timberlake (Williams, 1927, p. 71) wrote in his journal under date of January 2, 1762, that raccoons were numerous in the vicinity of Tellico River, Monroe County. On March 31, 1785, an act was passed by the General Assembly of the State of Franklin that made lawful the payment of land taxes in pelts and other specified commodities. The value of a raccoon skin was fixed at 1 shilling 3 pence (Ramsey, 1853, p. 297). On account of the deranged currency and the scarcity of specie or notes of specie-paying banks, the General Assembly of the State of Franklin passed an act authorizing the payment of salaries to civil officers in pelts beginning January 1, 1788. The salary of the secretary to the Governor was fixed at 500 raccoon skins (Williams, 1924, p. 215).

Five specimens from Greenbrier, Sevier County, are listed by Komarek and Komarek (1938, p. 149). They report that raccoons occur in the Great Smoky Mountains at all elevations but are more numerous at lower altitudes.

About 40 years ago Rhoads (1896, p. 197) stated that raccoons were "excessively abundant in the bottoms of West Tennessee." Raccoons were reported in 1937 to be quite rare in Fayette County. They are said to be fairly numerous, however, in the swamps along the Loosahatchie River, Shelby County, and along the bottoms of Obion River in Dyer and Obion Counties. Tracks were seen by Perrygo and Lingebach during April 1937 along a creek in a hardwood swamp near Reelfoot Lake, Obion County. Raccoons were reported (Will, 1884, p. 106) as being abundant near Savannah, Hardin County, during the winter of 1883–84. Local residents near Waynesboro in 1937 stated that raccoons were becoming scarcer in Wayne County. A few are caught each year near Crossville.

Benton County: Big Sandy, 1.
Montgomery County: Clarksville, 1.
Shelby County: Arlington, 1.

Family MUSTELIDAE

MARTES PENNANTI PENNANTI (Erxleben): Eastern Fisher, or Pekan

Although Dr. C. Hart Merriam (1888, p. 459), after having accompanied Henry Gannett, of the U. S. Geological Survey, several hundred miles through the Great Smoky Mountains of Tennessee and North Carolina, reported that the pekan was unknown in 1887 to local residents, reliable information exists that this animal formerly occurred in that area. Audubon and Bachman (1846, vol. 1, p. 314) refer to the former presence of the fisher as follows: "We have seen several skins procured in east Tennessee and we have heard of at least one individual that was captured near Flat Rock [? Cumberland County] in that State, latitude 35°." The Flat Rock was a well-known landmark when the wagon road from Clinch River to Nashville was opened for travel in 1795. Latitude 35°, however, is approximately the southern boundary of the State.

MUSTELA FRENATA NOVEBORACENSIS (Emmons): New York Weasel

The available specimens of this weasel were all taken in the eastern half of the State. Rhoads (1896, p. 196), however, states that it "is said to be common in west Tennessee." A weasel was taken at an altitude of 3,800 feet near Shady Valley on June 13, 1937, in a large-size Schuyler trap nailed to the trunk of an oak tree. Another weasel was trapped on Roan Mountain during September 1937 in a balsam-fir forest. Local residents in 1937 reported to Perrygo that weasels were fairly numerous at lower altitudes in the valleys of eastern Tennessee.

Curiously enough, the three weasels in the National Museum collection from the Allegheny Mountains of West Virginia, as well as the two collected in eastern Tennessee by the Museum party in 1937, are all somewhat darker than the Campbell and Hamilton County specimens. The coloration of the upper parts of these five specimens approaches Prout's brown or sepia. This coloration is of doubtful significance, since three specimens from 6,000 feet elevation on Roan Mountain, N. C., as well as five others from Magnetic City at the foot of Roan Mountain, have the usual cinnamon-brown coloration. Furthermore, in a series of 37 specimens from localities in Maryland, Virginia, and the District of Columbia, a young male and a young female have this dark-colored pelage.

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Specimens from Lower Ramsey Branch of the Little Pigeon River, from Pinnacle in Sevier County, and from Knoxville in Knox County are referred tentatively to the southern weasel (*M. n. notia*) by Komarek and Komarek (1938, p. 150).

Campbell County: Highcliff, 1.
Carter County: Roan Mountain, altitude 6,100 feet, 1.
Hamilton County: Walden Ridge, near Soddy, 3.
Johnson County: Holston Mountains, 4 miles northeast of Shady Valley, altitude 3,800 feet, 1.

MUSTELA VISON VISON Schreber: Mountain, or Black, Mink

The early records seem to indicate that the dark-colored mink was formerly common in the mountainous portion of eastern Tennessee. Under an act of the General Assembly of the State of Franklin, the remuneration of a constable serving a warrant was fixed at one mink skin beginning January 1, 1788 (Williams, 1924, p. 215). W. M. Perrygo was told in 1937 that a few minks are taken on Roan Mountain by local trappers, but that they are not so abundant as formerly. One mink was trapped and another seen in 1933 at Greenbrier, Sevier County (Komarek and Komarek, 1938, p. 150).

MUSTELA VISON MINK Peale and Beauvois: Common, or Brown, Mink

Minks were formerly generally distributed over most of Tennessee. In many localities they are now rather scarce, and high prices for pelts about 1920 almost resulted in their extermination in some counties. Minks were reported (Will, 1884, p. 106) very abundant near Savannah, Hardin County, during the winter of 1883–84. Local trappers reported in 1937 that minks were becoming rare in Shelby and Fayette Counties. Perrygo likewise learned from trappers that minks are caught occasionally in the vicinity of Reelfoot Lake, Obion County. Rhoads (1896, p. 198) lists a specimen from Open Lake, Lauderdale County.

LUTRA CANADENSIS INTERIOR Swenk: Mississippi Valley Otter

The otter doubtless occurred throughout Tennessee in early times, but persistent trapping by the early hunters and settlers soon reduced its numbers. No specimens have been received by the U. S. National Museum from the State, and it is therefore impossible to identify with certainty the race that may occur there now.

While residing with the Cherokee Indian chief Ostenaco at the mouth of Tellico River, Monroe County, Lt. Henry Timberlake on January 2, 1762, made a note in his journal (Williams, 1927, p. 69) concerning "brooks well stored with fish, otters, and beaver." Under an act of the General Assembly of the State of Franklin, passed and

signed on March 31, 1785, the value of a cased otter skin was fixed at 6 shillings and that of an uncased skin at 5 shillings (Ramsey, 1853, p. 297). The same Assembly in 1788 fixed the salary of the State treasurer at 450 otter skins (Williams, 1924, p. 215).

B. C. Miles reported to Rhoads (1896, p. 197) that he had seen an otter that was killed at Open Lake, Lauderdale County, during the winter of 1895. Rhoads also learned that otters were often seen by hunters at Reelfoot Lake.

SPILOGALE PUTORIUS (Linnaeus): Alleghenian Spotted Skunk

Howell (1909, p. 65) states that the spotted skunk was reported scarce in the vicinity of Briceville, Anderson County. Komarek and Komarek (1938, p. 150) list one specimen that was taken in the Great Smoky Mountains National Park but give no definite locality.

Campbell County: Highcliff, 1.
Sullivan County: Holston Mountains, head of Fishdam Creek, 1.

MEPHITIS MEPHITIS NIGRA (Peale and Beauvois): Eastern Skunk

The eastern skunk seems to be distributed in Tennessee west of the southern Allegheny Mountains. It occasionally takes up residence under a house or barn but generally is found in its own burrows or in abandoned burrows of some other animal. These are usually located in rocky terrain hidden by thickets or in clumps of brush at corners of rail fences. Rhoads (1896, p. 199) was told that skunks were "rare in the Mississippi lowlands" and reported that he "rarely detected the signs of this animal in Tennessee, though everyone seems to be acquainted with the animal in all localities visited except, perhaps, on the summits of the highest mountains." Perrygo reports that he saw no crushed skunks on the roads over which the Museum party drove their car during 1937 and that the familiar odor was not noted at any time except in the case of one taken in Lincoln County. This skunk was trapped in a rock ledge partially hidden in a hedgerow consisting of scrub cedar, briers, and cacti near farm buildings west of Fayetteville. Near Waynesboro one was killed in the deciduous woods on a rather dry hillside. Skunks were reported to be fairly common in Wayne County, but more skunks were said to be present in Lincoln County than in any other part of the State visited by the Museum party. The specimen from Campbell County, although not typical, is referred to *nigra* rather than to *elongata*, which occurs in eastern West Virginia.

Campbell County: Highcliff, 1.
Lincoln County: 2 miles west of Fayetteville, 1.
Wayne County: Waynesboro, 1.

MEPHITIS MEPHITIS ELONGATA Bangs: Florida Skunk

Five specimens taken in Sevier County at Greenbrier and Pinnacle are referred to the southern skunk by Komarek and Komarek (1938, p. 150).

Family CANIDAE

VULPES FULVA FULVA (Desmarest): Red Fox

The red fox seems not to have been one of the native mammals of Tennessee, but it has been introduced into various sections of the State at different times by those interested in hunting with hounds. Perrygo was told that red foxes have been liberated recently in a number of localities. Local residents informed him that red foxes were plentiful in the vicinity of Waynesboro, Wayne County, but that they were not common near Crossville, Cumberland County.

Contrary to general belief, Rhoads (1896, p. 200) states that the red fox was "always numerous in the mountains" but "has spread with increasing population into west Tennessee, where it was unknown to the early pioneers." Benjamin C. Miles is authority for the statement that this fox was introduced or migrated into Haywood and Lauderdale Counties about 1845.

Komarek and Komarek (1938, p. 150) mention a red fox that was found dead along Dudley Creek, Sevier County. From the Blount County Fox Hunters' Association they obtained information that in the years 1924 to 1926 approximately 150 red foxes were shipped from Waterloo, Minn., and liberated in the Chilhowee Mountains at several localities in the area between Sevierville and the Tennessee River.

UROCYON CINEREOARGENTEUS CINEREOARGENTEUS (Schreber): Gray Fox

The gray fox in former times occurred in most sections of the State and is still common in many localities. Hunting with hounds has resulted in the reduction and in some cases the extermination of this fox in the vicinity of thickly settled regions.

Lt. Henry Timberlake (Williams, 1927, p. 71) mentions that foxes were very abundant in 1762 along the Little Tennessee River near the mouth of Tellico River. Ramsey (1853, p. 206) states that when the first settlers came to the Bluff [Nashville] in 1780 foxes were present in the vicinity.

Under the act of March 31, 1785, of the General Assembly of the State of Franklin, the value of a fox skin was fixed at 1 shilling 3 pence (Ramsey, 1853, p. 297).

Local residents reported to Perrygo that gray foxes are occasionally caught in Fayette and Shelby Counties. He was told that gray foxes were still plentiful in the vicinity of Waynesboro, Wayne County. Similarly, trappers residing near Crossville informed him that this fox was no longer caught very often in Cumberland County.

In eastern Tennessee, Rhoads (1896, p. 200) states that the gray fox "sometimes courses over the balsam belt of Roan Mountain, when pursued by dogs, but does not reside at so great an altitude." Arthur Stupka, park naturalist, has informed me that specimens from Cades Cove, Blount County, and Elkmont, Sevier County, have been acquired by the museum of the Great Smoky Mountains National Park and that he has sight records from Gatlinburg, Sevier County, and elsewhere in the park. His observations indicate that the gray fox outnumbers the red fox at elevations below 2,000 feet.

Benton County: Big Sandy, 1.
Hamilton County: Walden Ridge, near Soddy, 2.

CANIS LUPUS LYCAON Schreber: Gray Wolf

Wolves, although once numerous, were exterminated in many sections of Tennessee many years ago. Unfortunately there are few published records.

The first recorded mention of wolves in eastern Tennessee appears to be that of James Needham (Williams, 1928, p. 27), who in 1673 saw wolves while traveling from near the present site of Trade, Johnson County, to the Cherokee Indian town Chota in what is now Monroe County. While engaged in carrying out a peace treaty with the Cherokee Indians, Lt. Henry Timberlake wrote in his journal (Williams, 1927, p. 71) under date of January 2, 1762, near the mouth of Tellico River, Monroe County, that there were an incredible number of wolves. Dr. C. Hart Merriam (1888, p. 459) wrote, after his trip through the region in 1887, that wolves were present in the Smoky Mountains. Rhoads (1896, p. 200) states that a wolf was seen during the winter, about 1883, near the Cloudland hotel on Roan Mountain and that a few may persist in the southern Alleghenies. Early settlers in the vicinity of Shady Valley, Johnson County, resorted to the use of high pen traps baited with live sheep to rid the country of wolves. Perrygo was shown the location of some of these trapping sites in the Holston Mountains. These pens were constructed of logs and built so that one side abutted against some abrupt cut in a gradual hill slope. A pack of wolves, having scented the bait, generally came down the slope and jumped into the pen, from which they could not escape. The trapped wolves were then killed with a gun or club.

References to wolves are more numerous in the early records of middle Tennessee. Ramsey (1853, p. 206) mentions that wolves were present in 1780 in the vicinity of the Bluff [Nashville]. Other records show that wolves were so numerous at the time the Nashville settlements were established that the settlers were compelled to build pens as traps. During the winter of 1788, when many of the settlers had sought refuge from the Indians at Rains Station [on Browns Creek, 2½ miles south of Nashville], the hunters, men and boys, would "occasionally visit their wolf and turkey pens" (Putnam, 1859, p. 296). An entry in the journal of André Michaux (Williams, 1928, p. 335) written at Nashville on June 21, 1795, indicates that wolves were present in the vicinity. Francis Baily (Williams, 1928, p. 407), while traveling the trail from Duck River to Nashville, mentions hearing the howling of wolves on June 29, 1797. In John Lipscomb's journal (Williams, 1928, p. 276) under date of June 29, 1784, it is recorded that two big buffalo bulls followed by a wolf were seen at a lick near Little Barren River [Macon County, Tenn., or Allen County, Ky.]. Abraham Steiner and Christian Frederic de Schweinitz, while traveling eastward on the Caney Fork road, stopped for a day or so at the cabin of a Mr. Shaw. Under date of December 12, 1799, they wrote in their journal (Williams, 1928, p. 519) that "here [Smith or Putnam County], in proximity to the wilderness, there are deer, bear, and wolves in great numbers." Williams (1930, pp. 96, 180) writes that in 1819 wolves attacked pigs, young calves, and fawns and that bounties were paid to the trappers and hunters for scalps of wolves. Audubon and Bachman (1851, vol. 2, p. 129) describe a pit trap that was used in Kentucky, and it is quite likely that similar wolf pits were constructed in western and middle Tennessee. In 1880 (Antler, p. 306) it was reported that gray wolves were occasionally found in the Caney Fork district, Van Buren County. It was reported to W. M. Perrygo that a female and her pups had been killed about 1917 near Waynesboro, Wayne County. Another wolf was killed in 1919 on North Fork River, Cumberland County.

No specific mention of gray wolves has been found in the early accounts of western Tennessee. Benjamin C. Miles (1895, p. 182) supposed that the large gray wolf extended its range into the river bottoms of Lauderdale County about 1890 or 1891. Subsequently he learned from Major Shaw (Rhoads, 1896, p. 200), an old hunter of Haywood County, that the latter had "captured a litter of seven wolf pups, three of which were gray and four black." Major Shaw was inclined to believe that the "big gray wolf has always been here and some favorable circumstance must have developed his numbers."

Some time later Miles wrote Rhoads (1896, p. 200) that two wolves had been poisoned about December 10, 1895, within 7 miles of Brownsville, Haywood County.

CANIS RUFUS FLORIDANUS Miller: Florida Red Wolf

A right mandible (U.S.N.M. no. 200145), referred to this wolf, was found by Clarence B. Moore in 1914–15 a short distance above Chattanooga in debris from the Citico aboriginal mound near Citico Creek, Hamilton County. It is quite likely that this red wolf ranged over southeastern Tennessee at least until the time of the arrival of the first white traders, since iron-blades manufactured by the whites were found at this site (Moore, 1915, pp. 373–374).

CANIS RUFUS GREGORYI Goldman: Mississippi Valley Wolf

The specific identity of the gray and black wolves of Tennessee is quite puzzling in view of conflicting statements. According to Benjamin C. Miles (1895, p. 182) the small black wolf was exterminated about 1870 in Haywood and Lauderdale Counties. Major Shaw (Rhoads, 1896, p. 200) says that "our present wolf is larger and very much fiercer than those of my childhood, at least those specimens were which came under my observation." Audubon and Bachman (1851, vol. 2, p. 130) refer to having seen black wolves on trips through southern Kentucky and mention one hunter who had trained a black wolf to trail deer. No specimens are available for examination. It is known, however, that the black phase is quite common in this species of wolf. Goldman (1937, p. 44) states that "a specimen from Cherokee, Colbert County, northwestern Alabama, is somewhat intermediate, but in heavy dentition is nearer *floridanus*."

CANIS LATRANS Say: Coyote

Coyotes are reported to have been introduced in Tennessee in recent years, though no information is at present available as to the source where they were obtained. A female killed in Maury County was acquired by the Tennessee State Museum in 1930. According to an item that appeared in the Migrant,[2] "it is believed that it is from a stock of coyotes that were liberated in west Tennessee at Grand Junction [Hardeman County] for the purpose of training hounds." The Bureau of Biological Survey obtained from Earl May the skin and skull of a female killed on May 23, 1931, at McCains.

Maury County: McCains, 1.

[2] Quart. Publ. Tennessee Orn. Soc., vol. 1, nos. 3–4, p. 19, Dec. 1930.

FELIS CONCOLOR COUGUAR Kerr: Cougar, Panther, or Eastern Mountain Lion

An entry in the journal of Lt. Henry Timberlake (Williams, 1927, p. 71) under date of January 2, 1762, indicates that panthers were numerous at that date in the vicinity of Tellico River, Monroe County. Dr. C. Hart Merriam, however, reported in 1888 (p. 459) that the panther was unknown in the Great Smoky Mountains region of Tennessee and North Carolina. Perrygo was told that a panther had been killed in 1929 in the Holston Mountains near Shady Valley, Johnson County. Another panther was seen crossing the trail on Roan Mountain on September 18, 1937.

Ramsey (1853, p. 206) states that panthers were present in 1780 in the vicinity of the Bluff [Nashville]. While staying at the home of a Mr. Shaw on the Caney Fork road [? Smith County], Abraham Steiner and Christian Frederic de Schweinitz wrote on December 12, 1799, that panthers were present in that vicinity. A panther was seen on May 30, 1937, by local residents on North Fork River near Crossville, Cumberland County.

Williams (1930, p. 96) writes that panthers were present in western Tennessee in 1819. Some years later Benjamin Porter, Jr., is reported to have killed on one day four full-grown panthers, which averaged 9½ feet in length, in Lauderdale County (Williams, 1930, p. 161). Hallock (1877, p. 153) stated that the canebrakes of Shelby County afforded fine grounds for hunting panthers. It is also reported that a panther measuring 7½ feet from tip to tip was killed by Robert H. Weaver on Wheatley's plantation, 8 miles south of Memphis (Anon., 1880, p. 11). Benjamin C. Miles reported to Rhoads (1896, p. 201) that a few panthers were said to occur in the most impassable brakes and "harricanes" of the bottoms of Lauderdale County.

LYNX RUFUS RUFUS (Schreber): Bobcat, or Wild Cat

The first mention of wild cats occurring in the State of Tennessee appears to be that recorded by Abraham Steiner and Christian Frederic de Schweinitz. On December 12, 1799, they recorded in their journal (Williams, 1928, p. 519) that wild cats occur near the Caney Fork road [Smith or Putnam County]. Williams (1930, pp. 96, 180) records the occurrence in 1819 of wild cats and catamounts in western Tennessee.

Perrygo was informed by local residents that wild cats are occasionally trapped in cypress swamps in Fayette and Shelby Counties. In the vicinity of Waynesboro, Wayne County, it was reported that there were still a few wild cats on the ridges and that a female had been killed there during March 1937. Local residents in the vicinity of

Crossville reported that there were relatively few wild cats in Cumberland County. The specimens from Walden Ridge are indistinguishable from those taken in eastern West Virginia.

Tracks were seen by Perrygo and Schaefer during September 1937 on Roan Mountain, and they were told that wild cats were not abundant in the Great Smoky Mountains. Komarek and Komarek (1938, p. 151), however, report that wild-cat tracks were frequently seen in Sevier County near Mount Guyot and on Brushy Mountain. Three specimens were taken by their party at Greenbrier, Sevier County. Wild cats are frequently trapped in the Cherokee National Forest. The Florida wild cat (*Lynx rufus floridanus*) may occur in this forest.

Hamilton County: Walden Ridge, near Soddy, 3.

Family SCIURIDAE

MARMOTA MONAX MONAX (Linnaeus): Southern Woodchuck, or Groundhog

During April and May 1937 Perrygo and Lingebach learned that a few woodchucks were to be found in the bluffs bordering the Mississippi River lowlands but that they were not common in any of the western counties drained by the small tributaries of the river. One was seen April 29, 1937, crossing the road northeast of Hornbeak, Obion County. In 1895, Benjamin C. Miles informed Rhoads (1896, p. 193) that woodchucks were very rare in Haywood County. As far back as the oldest residents could recall, no woodchucks have been found in Fayette and Shelby Counties.

In middle Tennessee, two were seen during May 1937 near Waynesboro, Wayne County. Local residents near Crossville reported to Perrygo in May 1937 that woodchucks were rather scarce in Cumberland County. On the western slope of the Clinch Mountains, a few occur in the farming sections near the Clinch River, Grainger County. According to Howell (1909, p. 60) woodchucks were reported as being common in Anderson County on Cross Mountain and in Hamilton County on Walden Ridge near Soddy. They also occur on the ridge between Fayetteville, Lincoln County, and Pulaski, Giles County.

Woodchucks appear to be slightly more abundant in eastern Tennessee. Perrygo and Lingebach found that there were a few living in the hedgerows bordering farming land in Shady Valley, Johnson County. Woodchucks were reported as being not at all abundant in the Great Smoky Mountains. A few were seen in the rocky ground between hemlock woods (altitude 2,700 feet) and an old abandoned field at Low Gap, 4½ miles southeast of Cosby, but only

one was trapped. In eastern Tennessee, according to Rhoads (1896, p. 193), the vertical range of the woodchuck does not extend upward into the fir belt, which begins approximately at an elevation of 5,000 feet. Two woodchucks were taken by the Museum party, however, during September 1937 at Carvers Gap on a bald spot at an altitude of 5,500 feet. A specimen from Greenbrier, Sevier County, is listed by Komarek and Komarek (1938, p. 151).

A few woodchucks occur along the edges of mixed deciduous and pine woods on Big Frog Mountain, Polk County, where no farming has been carried on for a great many years. In this region the vertical range of this animal goes up to at least 2,500 feet.

Campbell County: Highcliff, 1.
Carter County: Carvers Gap, Roan Mountain, altitude 5,500 feet, 2.
Cocke County: Low Gap, 4½ miles southeast of Cosby, altitude 2,700 feet, 1.
Humphreys County: Duck River, 6 miles southwest of Waverly, 1.
Polk County: Big Frog Mountain, 12 miles west of Copperhill, altitude 1,800 feet, 1.
Stewart County: Dover, 1.

TAMIAS STRIATUS STRIATUS (Linnaeus): Southeastern Chipmunk

Very few chipmunks were seen in Tennessee by the Museum party. Several were observed during June 1937 at an altitude of 3,800 feet in oak and beech woods on the Holston Mountains, 4 miles northeast of Shady Valley, Johnson County. Chipmunks appear to be more numerous here than at any other locality visited in 1937. Two were seen September 18, 1937, at an altitude of 4,000 feet on Roan Mountain, Carter County. One was seen during June 1937 at an altitude of 2,700 feet on Low Gap southeast of Cosby, Cocke County. Komarek and Komarek (1938, p. 152) state that chipmunks are common in the deciduous woods of the Great Smoky Mountains and list specimens from Eagle Rocks Prong of Little Pigeon River, Greenbrier, Horseshoe Mountain (about 3 miles east of Mount LeConte and 1½ miles north of Mount Kephart), Mount Harrison, and Porters Flats in Sevier County, and also from Thunderhead in Blount County. Rhoads (1896, p. 194) observed chipmunks at Johnson City, Washington County, and at Greeneville, Greene County. Howell (1909, p. 59) states that chipmunks were reported to occur at Highcliff, Campbell County, and on Walden Ridge near Soddy, Hamilton County, and that one was seen on Coal Creek in Anderson County.

In middle Tennessee, Rhoads observed chipmunks at Nashville, Davidson County, and mentioned two specimens taken at Warner, Hickman County, during November and December. No chipmunks were seen by Rhoads "at Chattanooga or Knoxville, nor on the Cumberland plateau." Perrygo reports that a few chipmunks were noted

in a hardwood forest 8 miles northeast of Waynesboro, Wayne County. Two were seen near Dover, Stewart County, October 30, 1937.

According to Rhoads, observations (1896, p. 193), chipmunks were "very sparingly and irregularly distributed in the lowlands of Tennessee." He observed them near the springs at Raleigh and along the road from Raleigh to Bartlett, Shelby County. Benjamin C. Miles informed Rhoads that he saw five or six chipmunks every summer near Brownsville, Haywood County. Chipmunks were not found to be very numerous in the sections of Obion and Lake Counties visited in 1937.

Hickman County: 1.
Johnson County: Holston Mountains, 4 miles northeast of Shady Valley, altitude 3,800 feet, 1.
Montgomery County: east of Clarksville, 1; Dunbars Cave, Clarksville, 4.
Obion County: Reelfoot Lake, Samburg, 1.
Stewart County: Cumberland River near Dover, 1.
Wayne County: 8 miles northeast of Waynesboro, 2.

TAMIASCIURUS HUDSONIUS ABIETICOLA Howell: Cloudland Red Squirrel, Pine Squirrel, or Boomer

No red squirrels were seen by the Museum party outside of the hemlock, spruce, and fir forests of eastern Tennessee, except in the pine woods of the Cherokee National Forest. One was seen during June 1937 at an altitude of 2,900 feet in a hemlock bog near Shady Valley. Rhoads (1896, p. 196) reports that "owing to the severe winter of 1894–95, the 'Boomer' was very scarce in its usual haunts on the summit of Roan Mountain." Red squirrels were rather scarce in 1937 in the balsam-fir and beech forests on Roan Mountain, Carter County, but Perrygo and Schaefer succeeded in collecting a few specimens. In the Great Smoky Mountains district it required considerable effort on the part of Perrygo, Lingebach, and Schaefer to collect even a few red squirrels in the balsam-fir forests on Mount Guyot, Old Black Mountain, and Inadu Knob. They were nowhere numerous, and local residents were of the opinion that red squirrels would be exterminated within a few years. Komarek and Komarek (1938, p. 152), however, report that red squirrels were abundant in 1931 and 1932 in the deciduous and evergreen forests of the Great Smoky Mountains and list specimens from the following localities in Sevier County: Buck Fork and Ramsey Prong of Little Pigeon River, Dry Sluice [Gap] (intersection of Richland Mountain with Tennessee-North Carolina boundary line), Greenbrier, Horseshoe Mountain, Mount Guyot, and Porters Flats. One was seen during July 1937 in pine woods at an altitude of 4,100 feet on Big Frog Mountain, Polk County.

Carter County: Roan Mountain, altitudes 5,000 to 6,100 feet, 4.
Cocke County: Inadu Knob, altitudes 4,500 to 5,900 feet, 7; Mount Guyot, altitude 6,500 feet, 2; Snake Den Mountain, altitude 4,500 feet, 1.
Sevier County: Indian Gap, altitude 5,200 feet, 2.

SCIURUS CAROLINENSIS CAROLINENSIS Gmelin: Gray, or Cat, Squirrel

The gray squirrel was formerly one of the commonest and most widely distributed mammals in Tennessee. It frequents not only the moist bottomlands and swamps, where there is an abundance of nut-bearing deciduous trees, but is also found on wooded hills and the lower mountain slopes. Four gray squirrels were seen and two collected in deciduous woods on Poor Valley Ridge, Clinch Mountains, Grainger County. Although both of these are young individuals, they appear to resemble *carolinensis* more closely than *leucotis*.

The gray squirrel is no longer abundant in the more settled parts of middle Tennessee. André Michaux (Williams, 1928, p. 335) refers to the presence in 1795 of small gray squirrels in the vicinity of Nashville. Four years later, Abraham Steiner and Christian Frederic de Schweinitz (Williams, 1928, p. 516) comment on the "tremendous number of squirrels" in the Cumberland settlements in the vicinity of Nashville. The Museum party did not collect or see any gray squirrels in middle Tennessee, except in the vicinity of Fayetteville, Lincoln County, where six were seen and two collected, and in the deciduous woods 8 miles north of Indian Mound, Stewart County, where two were seen.

Gray squirrels were fairly common in some parts of southwestern Tennessee. Only a few were actually seen, however, near Hickory Withe, Fayette County, during April 1937. Benjamin C. Miles (Rhoads, 1896, p. 196) in describing the migrations of gray squirrels from Arkansas to Tennessee states that he has "seen them exhausted and wet on the east bank of the Mississippi River." This would indicate that gray squirrels can swim considerable distances when necessary.

The hind feet of the specimens from Big Sandy average larger than those taken in the southern part of the State. The average measurements of 10 males from this locality are as follows: Total length, 453.5 (428–480); tail, 215.9 (207–230); hind foot, 66.2 (63–68). For six females from the same locality the average measurements are: Total length, 475.5 (460–485); tail, 225.3 (220–230); hind foot, 66.3 (63–68).

Benton County: Big Sandy, 18.
Campbell County: Highcliff, 4.
Fayette County: Hickory Withe, 1.

Grainger County: Poor Valley Ridge, Clinch Mountains, 3 miles northeast of Rutledge, altitude 1,200 feet, 2.
Hamilton County: Walden Ridge near Soddy, 3.
Lincoln County: 3 miles south of Fayetteville, 1; 3 miles north of Fayetteville, 2.
Shelby County: Arlington, 7.

SCIURUS CAROLINENSIS LEUCOTIS Gapper: Northern Gray Squirrel

Although not typical, the specimens from the southern Alleghenies and the Great Smoky Mountains in eastern Tennessee are referred to *leucotis*, since they resemble those taken on the north in the mountainous sections of eastern West Virginia in the predominance of whitish-tipped or whitish-gray-tipped hairs in the tail as well as large hind feet. The measurements of two males are, respectively: Total length, 457, 452; tail, 220, 215; hind foot, 69, 68. For two females the measurements are, respectively: Total length, 451, 454; tail 203, 205; hind foot, 67, 67.

Gray squirrels appeared to be fairly numerous in eastern Tennessee during 1937, although it was reported to Perrygo that they were rapidly diminishing in numbers. One gray squirrel was seen and another one collected in oak and beech woods on the Holston Mountains. Rhoads (1896, p. 196) reports that he had seen the skin of one taken at an altitude of 4,000 feet on Roan Mountain. Gray squirrels have been taken along Fighting Creek, at Greenbrier, on Horseshoe Mountain (about 3 miles east of Mount LeConte and 1½ miles north of Mount Kephart), and along the Ramsey Prong of Little Pigeon River in Sevier County, and also on Russell Field, Blount County (Komarek and Komarek, 1938, p. 153). Six were seen and two collected in mixed hardwood and pine woods on Big Frog Mountain.

Cocke County: Snake Den Mountain, altitude 3,600 feet, 1; Inadu Knob, altitude 5,000 feet, 1.
Johnson County: Holston Mountains, 4 miles northeast of Shady Valley, altitude 3,800 feet, 1.
Polk County: Sheeds Creek, Big Frog Mountain, 12 miles west of Copperhill, altitude 1,600 feet, 2.

SCIURUS NIGER NEGLECTUS (Gray): Northern Fox Squirrel

A few fox squirrels were reported to Perrygo to occur in the deciduous woods on the lower levels (altitude 1,500 to 2,000 feet) of Denny Mountains near Cosby, Cocke County. These are most likely referable to the northern race but can be only tentatively placed here until actual specimens are available for examination. These large, and generally white-bellied, long-tailed fox squirrels have been taken at two localities in Greenbrier County, W. Va., and should range southward in the southern Allegheny Mountains.

SCIURUS NIGER RUFIVENTER Geoffroy: Mississippi Valley Fox Squirrel

According to Benjamin C. Miles (Rhoads, 1896, p. 194) the fox squirrel is always found in big timber but prefers the gum and cypress trees in the swamps of Haywood and Lauderdale Counties. Fox squirrels appear to be most numerous in the northwestern corner of the State. During May 1937 one was seen near Union City, two were seen and one collected near Hornbeak, and one was collected on Green Island, Reelfoot Lake, Obion County. On returning to this county in October 1937, Perrygo saw two and collected one 3 miles south of Samburg. Perrygo learned from local residents that fox squirrels were no longer very numerous in Fayette and Shelby Counties. He was informed that none occur in the cypress swamp near Hickory Withe, Fayette County. Along the southern border of the State, a few fox squirrels were reported to occur in the woods south of Fayetteville, Lincoln County.

The upperparts of the skins from Obion and Lincoln Counties appear much darker than those from Campbell County. This condition appears attributable in part to wear, since the black subapical bands are more conspicuous than the grayish or buffy-gray hair tips. Howell (1909, p. 59) referred the small series from near the southern end of Pine Mountains in Campbell County to *Sciurus niger texianus*. The ground color of the upperparts of these specimens is more rufous than those from Obion County. As noted by Howell, five of these specimens have white noses and the underparts are rufous and not whitish like those referred to *neglectus*. Out of a series of 24 skins of *Sciurus niger neglectus* from eastern West Virginia, 14 have whitish underparts, 9 have the white underparts more or less suffused with yellowish or light rufous, and 1 has the underparts black. Three in this series have whitish noses. Howell also states that "fox squirrels are becoming scarce in many parts of the South, and specimens are often difficult to obtain."

Campbell County: Highcliff, 3 miles east of Jellico, 7.
Lincoln County: 3 miles south of Fayetteville, 1.
Obion County: Green Island, Reelfoot Lake, 1; Reelfoot Lake, 4 miles west of Hornbeak, 1; Reelfoot Lake, 3 miles south of Samburg, 1.

GLAUCOMYS VOLANS SATURATUS Howell: Southeastern Flying Squirrel

Flying squirrels are inhabitants of woods and generally reside in hollow trees, abandoned woodpecker holes, or cavities in stumps. Although rather active at night in good weather, they are seldom seen and frequently are common without their presence being generally known. In middle Tennessee, five were trapped in the deciduous woods along Birds Creek, 7 miles southwest of Crossville, Cumberland County. A dead young one was seen caught in a wire fence

at the same locality. Five were trapped in deciduous woods north of Waynesboro, Wayne County. Another one was trapped on an oak tree near Frankewing, Lincoln County. Howell (1918, p. 24) lists one specimen from Nashville, Davidson County.

In the southwestern corner of the State, four were trapped in the cypress swamp near Hickory Withe, Fayette County. Local residents did not know that flying squirrels were present in this area. In the lowlands of Haywood County flying squirrels were common according to B. C. Miles (Rhoads, 1896, p. 197), and in 1890 he routed 30 out of his martin box. Flying squirrels seemed to be less numerous in the northwestern corner of the State. Only two were trapped in Obion County, one on a beech tree south of Hornbeak and another one near Samburg.

This southern race resembles *volans* rather closely in external measurements, and typical specimens are darker than the latter. Most of the Tennessee specimens referred to this race have lighter upperparts than those from Alabama listed by Howell (1918, p. 25). The average measurements of eight males are as follows: Total length, 223.7 (211–237); tail vertebrae, 97.2 (93–101); hind foot, 30.1 (29–31). For 11 females the average measurements are: Total length, 221.7 (205–233); tail vertebrae, 94.5 (88–102); hind foot, 30.1 (28–32).

Cumberland County: 7 miles southwest of Crossville, 6.
Fayette County: Hickory Withe, 4.
Lincoln County: 6 miles southwest of Frankewing, 1.
Obion County: Reelfoot Lake, 3 miles south of Samburg, 1; Reelfoot Lake, 5 miles west of Hornbeak, 1.

GLAUCOMYS VOLANS VOLANS (Linnaeus): Small Eastern Flying Squirrel

These small flying squirrels appeared to be rather common in the Holston Mountains northeast of Shady Valley, for eight were taken in Schuyler traps nailed to the trunks of oak and beech trees at elevations of 3,000 to 3,800 feet. One was taken on the trunk of an oak tree at an altitude of 4,200 feet on Roan Mountain.

Specimens from Greenbrier, Sevier County, and Knoxville, Knox County, are listed by Komarek and Komarek (1938, p. 154).

Detailed comparisons of the series from the mountainous section of eastern Tennessee with a comparable series from eastern West Virginia failed to reveal any valid differences. It should be noted, however, that relatively few specimens from the southern Allegheny Mountains were available when Howell (1918) revised this genus. In the winter pelage, the toes and the fore parts of the feet are generally whitish in *volans* in contrast to the rather uniformly dark feet of *saturatus*, although the external measurements of this race do not differ appreciably from those of the latter. The

average measurements of five males are as follows: Total length, 217 (202–234); tail vertebrae, 91 (75–101); hind foot, 29.8 (28–31). For eight females the average measurements are: Total length, 230.7 (210–241); tail vertebrae, 102.6 (95–116); hind foot, 30.5 (29–32).

Carter County: Watauga Valley, 2; Roan Mountain, altitude 4,100 feet, 1.
Cocke County: Snake Den Mountain, altitude 4,700 feet, 1.
Johnson County: Holston Mountains, 3 miles northeast of Shady Valley, altitudes 3,000 to 3,800 feet, 6; Holston Mountains, 4 miles northeast of Shady Valley, altitude 3,000 feet, 2.
Polk County: Big Frog Mountain, 12 miles west of Copperhill, altitude 2,000 feet, 1.
Wayne County: Waynesboro, 8 miles north, 6.

GLAUCOMYS SABRINUS FUSCUS Miller: West Virginia Flying Squirrel

The trapping of a male of this gray-faced flying squirrel on September 23, 1927, in a birch forest on the north slope of Roan Mountain, Carter County, extends the range of this race more than 200 miles south of Cranberry Glades, W. Va. This specimen was caught in a large-size Schuyler trap nailed to the trunk of a large birch tree. No additional information has been secured in regard to the habits of this flying squirrel.

Carter County: Roan Mountain, altitude 5,500 feet, 1.

Family CASTORIDAE

CASTOR CANADENSIS CAROLINENSIS Rhoads: Carolina Beaver

When the French, Virginia, and Carolina traders first visited the Indian settlements in what is now Tennessee, beavers were generally distributed in the watercourses over the whole State. Many traders were bartering for pelts long before 1700, but it is quite unlikely that any marked depletion of the beaver stock took place until after 1760.

Lt. Henry Timberlake, on his trip down the Holston River during December 1761 from Kingsport, Sullivan County, to a large cave below the present site of Three Springs Ford, Hamblen County, commented on the abundance of beavers along that watercourse (Williams, 1927, p. 47). The same traveler stated that beavers were plentiful along the Little Tennessee near the mouth of Tellico River (Williams, 1927, p. 69).

According to the verdict brought in by a jury and signed by Andrew Jackson, attorney for the State, the value of a beaver skin stolen in 1780 in Davidson County was given as 30 shillings (Lewis, 1903, pp. 294–295). This is rather interesting, for under the act of March 31, 1785, of the General Assembly of the State of Franklin,

the value of a "good, clean beaver skin" was fixed at 6 shillings (Ramsey, 1853, p. 297). The same Assembly fixed the salary of each county clerk at 300 beaver skins, the clerk of the House of Commons at 200 beaver skins, and members of the Assembly at 3 beaver skins, beginning January 1, 1788 (Williams, 1924, p. 215).

According to an entry in the journal of André Michaux (Williams, 1928, p. 335) under date of June 21, 1795, beavers were present in the vicinity of Nashville. Williams (1930, p. 96) states that in 1819 beavers were still present in western Tennessee, without giving any definite localities.

Rhoads (1896, pp. 192–193) examined a beaver house in the cypress swamp bordering Reelfoot Lake, about 3 miles west of Samburg, Obion County, and was told by his guide, H. B. Young, that there were 20 beavers in that district. B. C. Miles informed Rhoads that he knew of an inhabited beaver house within 9 miles of Brownsville, Haywood County.

Under the pen name "Will" (1884, p. 106), a resident of Savannah, Hardin County, wrote on February 11, 1884, as follows: "A few foxes and otters, several beavers, and multitudes of raccoons have been trapped here this winter. There are parties who make good wages trapping, as minks and 'coons are very abundant."

Family CRICETIDAE

REITHRODONTOMYS HUMULIS HUMULIS (Audubon and Bachman): Eastern Harvest Mouse

Although this harvest mouse is known at present from only one locality in the south-central part of the State, it is quite likely that it ranges over most of middle Tennessee. It seems to prefer old fields and tangled brier patches bordering cultivated fields, especially areas where there is an abundance of matted grass, broomsedge, or weeds. One was trapped at Giles in a cotton-rat runway in a pasture overgrown with broomsedge.

Six specimens are recorded by Komarek and Komarek (1938, p. 154) as having been taken in Sevier County in broomsedge areas around apple trees; another specimen was trapped in a similar field along Laurel Branch in Greenbrier.

Giles County: 6 miles east of Pulaski, 1.

PEROMYSCUS MANICULATUS BAIRDII (Hoy and Kennicott): Prairie White-footed Mouse

The discovery by Perrygo and Lingebach of this short-tailed white-footed mouse in Fayette County has extended its range in the Mississippi Valley at least 250 miles south of previously known Illinois records. Seven were trapped alongside of logs in a drained cypress

swamp near Hickory Withe. Inasmuch as the Campbell County specimens were taken near one of the smaller tributaries of the upper Cumberland River, this mouse may occur elsewhere along areas drained by that river.

For three males from Hickory Withe the measurements are, respectively: Total length, 153, 145, 141; tail, 60, 61, 59; hind foot, 18.5, 19, 18. The measurements of two females from Hickory Withe are, respectively: Total length, 166, 137; tail 67, 56; hind foot, 19, 19.

Campbell County: La Follette, 2.
Fayette County: Hickory Withe, 7.

PEROMYSCUS MANICULATUS NUBITERRAE Rhoads: Cloudland White-footed Mouse

The range of this mouse so far as known is restricted to the eastern part of the State, occurring chiefly at higher altitudes of the southern Alleghenies. Though most plentiful in forests of the Canadian Zone, they frequently occur at lower altitudes in rhododendron thickets bordering cold mountain streams. Contrary to the assumption of Rhoads (1896, p. 188) that the Cloudland deer mouse was "exclusively a dweller of the balsam or spruce belt," which crowns the summits of the southern Allegheny Mountains, it is now known to range downward into the hemlock timber as low as 2,700 feet.

Of the 14 taken during July 1937 by Perrygo and Lingebach near Shady Valley, 4 came from a hemlock and rhododendron bog behind camp (altitude 2,900 feet). The remainder were caught either among moss-covered boulders in a dense hemlock forest on the southeastern slope of Holston Mountains or in large-size Schuyler traps set for flying squirrels on the trunks of beech and oak trees (altitude 3,800 feet). These mice were found on the west slope of Roan Mountain in spruce and fir timber as low as 5,000 feet and up into the balsam fir forest at 6,300 feet, chiefly where there was a thick undergrowth of rhododendron. Near the foot of the west slope of Low Gap, these mice were trapped at an altitude of 2,700 feet around the moss-covered roots of hemlock trees. The sun never penetrates in this heavy hemlock timber, and the cool air may explain their presence at this low level. On Inadu Knob these mice were trapped at an altitude of 4,500 feet in a dense rhododendron undergrowth in hemlock and spruce woods and also at an elevation of 5,700 feet in birch and spruce. They are somewhat arboreal, for the majority of those collected on Inadu Knob were taken in large-size Schuyler traps nailed to trunks of spruce trees about 6 feet above the base. On the west slope of Mount Guyot and likewise on Old Black Mountain, these mice were caught in runways in the moss growing around the roots of balsam fir. On Snake Den Mountain, they were taken at an altitude of 3,700 feet along the banks of a swift mountain stream

in a dense growth of rhododendron in oak, birch, maple, and hemlock woods. At 4,500 feet they were trapped between the rocks around the roots of hemlock trees. Komarek and Komarek (1938, pp. 154–155) trapped this mouse in spruce forests along the divide of the Great Smoky Mountains and at lower elevations in shaded ravines and forested areas with dense crown. They list specimens from the following localities in Sevier County: Buck Fork, Chapman Prong, Eagle Rocks Prong, Ramsey Prong, and Walker Prong of Little Pigeon River, Brushy Mountain, Grassy Patch (on Alum Cave Creek, 2 miles east of The Chimneys), Greenbrier, Mount Guyot, and Silers Bald. Specimens were taken also at Russell Field and Thunderhead in Blount County.

This white-footed mouse may be recognized readily by its long penicillate tail. The average measurements of 10 males from Inadu Knob (2), Snake Den Mountain (2), Low Gap (1), and Roan Mountain (5) are as follows: Total length, 180.5 (174–185); tail, 92.5 (87–98); hind foot, 20.1 (20–21). For 12 females from Indian Knob (3), Low Gap (1), Snake Den Mountain (4), Roan Mountain (4) the average measurements are as follows: Total length, 182.9 (170–196); tail, 91 (76–98); hind foot, 20.45 (19.5–22).

Carter County: Roan Mountain, altitudes 5,000 to 6,300 feet, 11.

Cocke County: Low Gap, 4½ miles southeast of Cosby, altitudes 2,700 to 3,400 feet, 6; Inadu Knob, altitudes 4,500 to 5,700 feet, 13; Mount Guyot, altitude 6,300 feet, 1; Old Black Mountain, altitude 6,300 feet, 1; Snake Den Mountain, altitudes 3,700 to 4,500 feet, 11.

Johnson County: Holston Mountains, 3 miles northeast of Shady Valley, altitude 3,000 feet, 4; Holston Mountains, 4 miles northeast of Shady Valley, altitude 3,800 feet, 5; Shady Valley, altitude 2,900 feet, 5.

Sevier County: Indian Gap, altitude 5,200 feet, 2.

Sullivan County: Holston Mountains, head of Fishdam Creek, 1.

PEROMYSCUS LEUCOPUS LEUCOPUS (Rafinesque): White-footed Deer Mouse

This white-footed mouse is generally found in upland woods but occurs also along the borders of poorly kept cultivated fields, especially where the hedgerows or fences are a tangled mass of bushes and briers. At higher elevations it has been found living in crevices in rock ledges. In the vicinity of Samburg, Rhoads (1896, p. 187) found that these mice "seemed to frequent the intermediate grounds between the overflowed bottoms and the bluff." Osgood (1909, p. 117) lists five specimens from Samburg, Obion County. Five were caught by Perrygo and Lingebach in wet boggy places in the deciduous woods near Reelfoot Lake, Obion County. Rhoads (1896, p. 187) trapped this mouse at Raleigh, Shelby County, and at Belleview, Davidson County. They were rather numerous in sparse second-growth deciduous woods on the dry hillside north of Waynesboro,

Wayne County. Others were trapped in rock ledges in the woods along Birds Creek, south of Crossville, and in mixed pine and hardwoods on the Cumberland Plateau near Melvine. Near Pulaski and also at Frankewing, Perrygo trapped this mouse during November 1937 in patches of cacti growing on rocks in clumps of scrub cedar.

The average measurements of 12 males from Waynesboro (3), Frankewing (1), Crossville (2), Melvine (1), Big Sandy (1), and Reelfoot Lake (4) are as follows: Total length, 162.4 (152–171); tail, 71 (59–79); hind foot, 20 (19.5–21). For 7 females from Waynesboro (2), Pulaski (1), Big Sandy (2), Clarkesville (1), and Reelfoot Lake (1) the average measurements are: Total length, 170.5 (156–181); tail, 73.28 (67–83); hind foot, 20.2 (20–22).

Anderson County: Briceville, 1.
Benton County: Big Sandy, 9.
Cumberland County: Birds Creek, 7 miles southwest of Crossville, 2; Melvine, 1.
Davidson County: Nashville, 5.
Giles County: 10 miles east of Pulaski, 1.
Henderson County: Lexington, 2.
Houston County: Danville, 1.
Lincoln County: 6 miles east of Frankewing, 1.
Montgomery County: Clarksville, 4; Dunbars Cave, 1.
Obion County: Samburg, 1; Reelfoot Lake, 5 miles west of Hornbeak, 5.
Selby County: Arlington, 4.
Wayne County: 8 miles north of Waynesboro, 6.

PEROMYSCUS LEUCOPUS NOVEBORACENSIS (Fischer): Northern White-footed Mouse, or Deer Mouse

The specimens from eastern Tennessee are not typical, although they do not differ appreciably from those taken in the mountainous section of eastern West Virginia. Two were taken on June 15, 1937, in a hemlock and rhododendron bog behind the camp at Shady Valley. At an altitude of 3,800 feet on the Holston Mountains, 4 miles northeast of Shady Valley, one was trapped in a large-size Schuyler trap nailed to an oak tree for flying squirrels.

For two males from Watauga Valley the measurements are, respectively: Total length, 161, 157: tail, 69, 66; hind foot, 20, 19.5. For two females from Johnson County and one female from Watauga Valley, the measurements are, respectively: Total length, 186, 172, 176; tail, 83, 83, 76; hind foot, 21.5, 22, 20. Komarek and Komarek (1938, p. 155) have commented on the difficulty of identifying subspecifically the white-footed mice of this area and refer specimens taken in Sevier County along Fish Camp Prong of Little River, at Greenbrier, and on Porters Flats provisionally to *Peromyscus leucopus leucopus*.

Carter County: Watauga Valley, 5.
Johnson County: Holston Mountains, 4 miles northeast of Shady Valley, altitude 3,800 feet, 1; Shady Valley, altitude 2,900 feet, 2.

PEROMYSCUS GOSSYPINUS MEGACEPHALUS (Rhoads): Rhoads's Cotton Mouse, or Cane Mouse

The cotton mouse may occur in suitable localities throughout western and middle Tennessee. It seems to show some preference for cliffs and rocky bluffs, especially caves and crevices, and is found also in brushy thickets and timbered uplands, as well as in swampy areas. Rhoads (1896, p. 189) found this mouse abundant in deciduous woods with dense underbrush in the lowest and wettest parts of overflowed lands bordering Reelfoot Lake near Samburg, Obion County. In the vicinity of Big Sandy, G. A. Coleman trapped cotton mice in timbered bottomlands. The same collector caught others in traps set under rocks near the mouth of Dunbars Cave near Clarksville.

Cotton mice seem to prefer open woodlands and the growths of brush bordering old cultivated fields in the Great Smoky Mountains National Park, according to Komarek and Komarek (1938, p. 156). Specimens were collected by their field party at Greenbrier and along Fighting Creek near Gatlinburg in Sevier County.

This large-footed mouse resembles *leucopus* in general coloration but attains a somewhat larger size. For six males from Arlington (4) and Duck River (2) the average measurements are as follows: Total length, 189.4 (179–200); tail 84.5 (78–90); hind foot, 24.08 (23–25). The average measurements of nine females from Arlington (3), Big Sandy (1), Clarksville (4), and Duck River (1) are as follows: Total length, 190.7 (170–205); tail, 83.44 (78–92); hind foot, 23.55 (23–25).

Benton County: Big Sandy, 3.
Campbell County: Highcliff, 1.
Humphreys County: Duck River, 6 miles southwest of Waverly, 3.
Lawrence County: Lawrenceburg, 1.
Montgomery County: Clarksville, 7.
Shelby County: Arlington, 9.

PEROMYSCUS NUTTALLI NUTTALLI (Harlan): Northern Golden Mouse

The golden mouse may be recognized by its soft, thick pelage and heavily furred underparts, the white of the latter being suffused with ochraceous. At an altitude of 3,000 feet in a dense hemlock forest on the southeast slope of the Holston Mountains, golden mice were caught by Perrygo and Lingebach in traps set among moss-covered boulders. They have been taken along the borders of broomsedge fields, brier patches, and old fences near Fighting Creek, Greenbrier, and Porters Flats in Sevier County (Komarek and Komarek, 1938, p. 156). In middle Tennessee they may occur in swampy woodland, as well as on brushy hillsides and in dry thickets bordering timber.

Campbell County: Highcliff, 1.
Carter County: Roan Mountain Station, altitude 2,500 feet, 1.
Johnson County: Holston Mountains, 3 miles northeast of Shady Valley, altitude 3,000 feet, 4.
Knox County: Knoxville, 1.

ORYZOMYS PALUSTRIS PALUSTRIS (Harlan): Rice Rat

The rice rat frequents wet marshy areas in fields, wooded swamps, grassy bottomlands, and occasionally the edges of cultivated fields. A female trapped by A. H. Howell on September 13, 1908, near Lawrenceburg contained four embryos.

Komarek and Komarek (1938, p. 156) record the finding of a dead rice rat on the sill of an old barn near a marshy creek in Greenbrier (altitude 2,200 feet), Sevier County. Specimens from three widely separated localities indicate that rice rats may occur in suitable localities over most of the State west of the mountains of eastern Tennessee.

Campbell County: Highcliff, 1.
Lawrence County: Lawrenceburg, 2.
Shelby County: Arlington, 1.

SIGMODON HISPIDUS HISPIDUS Say and Ord: Eastern Cotton Rat

The cotton rat makes runways in old fields overgrown with grass and weeds, under brush and weeds growing along borders of cultivated fields, as well as in marshes. Near Hickory Withe, Perrygo trapped cotton rats in runways under a scraggly hedgerow bordering a cottonfield. Cotton rats were apparently abundant in the vicinity of Pulaski during November 1937. Numerous runways were noted in an abandoned field covered with matted grass and broomsedge and likewise on a nearby dry hillside. Cotton rats were taken in 1931 and 1932 by Komarek and Komarek (1938, pp. 156–157) in a field overgrown with broomsedge near Greenbrier (altitude 1,700 feet), Sevier County. They state that these rats occur also near Knoxville, Knox County.

Hamilton County: Soddy [Rathburn Station], 1.
Fayette County: Hickory Withe, 3.
Giles County: 1 mile east of Pulaski, 5.
Lincoln County: 6 miles east of Frankewing, 1.

NEOTOMA FLORIDANA HAEMATOREIA Howell: Blood Mountain Wood Rat

The range of this wood rat in Tennessee seems to be restricted to the eastern Great Smoky Mountains. Arthur Stupka, park naturalist, Great Smoky Mountains National Park, submitted to the U. S. Biological Survey for identification two specimens taken 3

miles above Townsend, on Little River, Blount County. These specimens were caught, respectively, at 1,200 and 1,400 feet altitude. The type specimen was collected by Dr. Francis Harper near the summit of Blood Mountain, altitude 4,400 feet, Lumpkin County, Ga. A. H. Howell in 1931 trapped an immature individual of this race at Highlands, Macon County, N. C., about 40 miles south-southeast of the Tennessee line.

NEOTOMA FLORIDANA ILLINOENSIS Howell: Illinois Wood Rat

This wood rat may inhabit the bluffs and swamp bottomlands bordering the Mississippi River. Rhoads (1896, p. 192) received information from hunters that some form of wood rat occurred in southwestern Tennessee.

NEOTOMA PENNSYLVANICA Stone: Allegheny Wood Rat

The recorded occurrences of this wood rat are all east of the northward-flowing portion of the Tennessee River, but no specimens, so far as known, have been taken in eastern Tennessee. Rhoads (1896, p. 192) states "that this large mountain-dwelling rat [*Neotoma magister*] is found in the cliffs of Roan Mountain and other peaks of the Southern Alleghenies," although he cites no definite Tennessee records. Howell (1909, p. 62) reported that there were numerous signs of wood rats in the rocky bluffs on Walden Ridge, and he found signs also in the bluffs along a creek near Lawrenceburg.

Hamilton County: Walden Ridge, near Soddy (3 miles southwest of Rathburn), 10.
Humphreys County: Duck River, 2 miles southwest of Waverly, 2.
Lawrence County: Lawrenceburg, 1.
Montgomery County: Clarksville, 1.

SYNAPTOMYS COOPERI STONEI Rhoads: Stone's Mouse Lemming

This mouse occurs in sphagnum bogs, bluegrass pastures, old abandoned fields, and hillsides. Rhoads (1896, p. 183) trapped "a lately nursing female and five young * * * in a small springy place on the Carolina side of the summit of Roan Mountain." Komarek and Komarek (1938, p. 157) stated that these lemming mice were taken in grassy patches on the mountains of Sevier County at the following localities: Buck Fork and Roaring Fork of Little Pigeon River, Greenbrier, Little River (altitude 2,900 feet), and Silers Bald. It was found also on the grassy bald known as Spence Field (altitude 5,000 feet), about 1 mile west of Thunderhead Mountain, Blount County.

Hawkins County: Rogersville, 1.
Sevier County: Indian Gap, 1.

CLETHRIONOMYS CAROLINENSIS (Merriam): Carolina Red-backed Mouse, or Wood Vole

The recorded occurrences of this red-backed mouse are all in the eastern mountainous portions of the State. The vertical range here extends from about 3,000 to 6,500 feet. In the Holston Mountains northeast of Shady Valley these mice were trapped in the moss covering the roots of trees and rotten logs in hemlock timber. On Roan Mountain, Mount Guyot, Old Black Mountain, and Inadu Knob red-backed mice were caught in traps set in clumps of moss around roots of balsam fir. Rhoads (1896, p. 186) writes, "Contrary to my expectations, the wood vole of Roan Mountain was not found in wet places but seemed to prefer rather open runways among the fallen logs, moss and ferns on the borders of the forest * * *. Such situations were preferred to the depths of the forest, owing to the variety of edible grasses and weeds only found in clearings." Red-backed mice were trapped by Komarek and Komarek (1938, p. 157) in the humid forests as well as around isolated shrubs on the grassy balds at elevations above 3,000 feet. They list specimens from the following localities in Sevier County: Buck Fork and Chapman Prong of Little Pigeon River and Mount Guyot. It was also taken in Blount County at Spence Field, a grassy bald located about 1 mile west of Thunderhead Mountain.

Carter County: Roan Mountain, altitude 6,000 to 6,300 feet, 6.

Cocke County: Inadu Knob, altitude 5,700 feet, 4; Mount Guyot, altitude 6,300 to 6,500 feet, 9; Old Black Mountain, altitude 6,300 feet, 6.

Johnson County: Holston Mountains, 3 miles northeast of Shady Valley, altitude 3,000 feet, 6.

Sevier County: Indian Gap, altitude 5,200 feet, 10.

MICROTUS PENNSYLVANICUS PENNSYLVANICUS (Ord): Pennsylvania Meadow Mouse, or Vole

There are no specimens of this vole from Tennessee in the National Museum collection. Rhoads (1896, p. 185) stated that he felt justified in including this mouse among the mammals listed for Tennessee since "on the summit of Roan Mountain two specimens of the meadow vole were secured in a little 'bulrush' swamp below Cloudland hotel, about 100 yards from the Tennessee line in Mitchell County, N. Carolina." Furthermore, runways similar "to those in which the Mitchell County specimens were taken were observed in swampy ground near the summit of the mountain in Carter County, Tennessee, during my ascent thither from the Doe River ravine." Perrygo trapped without success at this same locality from September 14 to 22, 1937.

MICROTUS CHROTORRHINUS CAROLINENSIS Komarek: Smoky Mountain Rock Vole

This vole was found by Komarek (1932, pp. 155, 158) on "the wooded slopes above 3,000 feet altitude of the Great Smoky Mountains," Sevier County, Tenn., and Swain County, N. C. Two were trapped at an elevation of approximately 4,300 feet on the Dry Sluice Trail near the divide (Mount Collins), Sevier County. The type locality is about 5 miles north of Smokemont, on a tributary of Bradley Fork, a small branch of the Oconalufty River, altitude 3,200 feet, Swain County, N. C. Komarek reports that these voles were trapped "near rotted and moss-overgrown logs resting on rocky terrain, near rhododendron thickets," in a "rather open forest having a dense crown." All were caught within 50 yards of small mountain streams. Subsequent field work by Komarek and Komarek (1938, p. 158) revealed that this rock vole was most plentiful around mossy rocks and logs in the humid forests and in rock outcrops on the grassy balds. They list specimens from the following localities in Sevier County: Buck Fork, Chapman Prong, and Eagle Rocks Prong of Little Pigeon River, Sawtooth Mountain (on the Tennessee-North Carolina boundary line, 5 or 6 miles northeast of Newfound Gap), Silers Bald, and Thunderhead.

MICROTUS OCHROGASTER (Wagner): Prairie, or Buff-bellied, Meadow Mouse

A small series of these voles was trapped by Perrygo and Lingebach during April 1937 in runways in an abandoned cloverfield, overgrown with broomsedge and weeds, near Reelfoot Lake. A. H. Howell collected three of these mice during July 1910 near Clarksville.

Lake County: Reelfoot Lake, 3 miles north of Tiptonville, 8.
Montgomery County: Clarksville, 3.

PITYMYS PINETORUM AURICULARIS (Bailey): Bluegrass Vole, or Southern Pine Mouse

This pine mouse shows some preference for the bluegrass barrens of Kentucky and northern Tennessee, digging tunnels in the edges of old fields and open grassy places. Underground burrows made by these mice are found also along the borders of cultivated fields, meadows, and pastures adjoining woods. Rhoads (1896, pp. 185–186) trapped them near Samburg in Obion County, Raleigh in Shelby County, Belleview in Davidson County, and Harriman in Roane County. Near Hickory Withe, Perrygo trapped one pine mouse

in a runway in heavy matted bluegrass on low ground bordering a cottonfield. A pine vole taken June 17, 1937, at Norris, Anderson County, was submitted for identification by Dr. A. H. Cahn.

Campbell County: Highcliff, 2; La Follette, 1.
Fayette County: Hickory Withe, 1.

PITYMYS PINETORUM SCALOPSOIDES (Audubon and Bachman): Northern Pine Mouse

The northern pine mouse is mainly a forest vole and is usually found along the margins of wooded tracts, but it spreads into dense forests during periods of abnormal abundance. It has been trapped on rocky hill slopes, in dense woods where there is a thick carpet of matted leaves, at low altitudes along the moist banks of mountain streams, and in sphagnum swamps. In eastern Tennessee it has been caught also along edges of cultivated fields. Komarek and Komarek (1938, p. 159) state that pine mice were taken in tunnels in an apple orchard and also in a marshy area bordering woods at Greenbrier, Sevier County, and under matted leaves in open deciduous woods at Cades Cove, Blount County.

Carter County: Watauga Valley, 1.
Hawkins County: Rogersville, 1.

ONDATRA ZIBETHICA ZIBETHICA (Linnaeus): Muskrat

The common muskrat formerly occurred in most of the streams and ponds of Tennessee. At the time the early traders and trappers penetrated into the State, pelts of muskrats apparently were not an important item for barter. No reference is made to them in published accounts until 1788, when the General Assembly of the State of Franklin fixed the compensation for a justice in signing a warrant at one muskrat skin (Williams, 1924, p. 215). André Michaux, while residing at Nashville in 1795, listed (Williams, 1928, p. 335) the muskrat as occurring in the vicinity. Rhoads (1896, pp. 186–187) concluded that the food of the muskrat in Tennessee consisted very largely of mussels. In a fish dam on the Holston River, near its junction with the French Broad River [Knox County], Rhoads found that mussel shells had been wedged in among the rocks by the muskrats.

Local residents of Fayette and Shelby Counties reported to Perrygo that muskrats were getting scarce since the drainage of the cypress swamps. A few muskrats are trapped each year in the marshes around Reelfoot Lake. Perrygo and Schaefer found that they were fairly common during October 1937 along the Cumberland River and some of its smaller tributaries west of Indian Mound.

Those collected were trapped in slides on the river banks and no houses were seen. A few occur along Clinch River near Bean Station [11 miles northeast of Rutledge], Grainger County. Local residents did not believe that any muskrats were left around Roan Mountain Station. Komarek and Komarek (1938, p. 159) report that a muskrat was trapped on Little Pigeon River, 2 miles below Greenbrier, Sevier County.

According to Howell (1909, p. 63) muskrats were reported to be numerous near Briceville, Anderson County, and common near Highcliff, Campbell County.

Campbell County: Highcliff, 5.
Carter County: Roan Mountain Station, 1; Watauga Valley, 1.
Stewart County: Cumberland River, 2 miles west of Indian Mound, 3.

Family MURIDAE

RATTUS RATTUS RATTUS (Linnaeus): Black Rat

The black rat appears to have been introduced at an early date into Tennessee. It may be recognized by its slender body, long tail, and blackish coloration. B. C. Miles, of Brownsville, Haywood County, wrote Rhoads (1896, p. 192) that black rats were formerly present in western Tennessee but that he had seen none for 20 years. Komarek and Komarek (1938, p. 159) state that the black rat is abundant around barns and that three were trapped at Greenbrier, Sevier County.

RATTUS RATTUS ALEXANDRINUS (Geoffroy): Roof Rat

This slender, long-tailed rat, with whitish or yellowish underparts, prefers the attics of houses or the roofs of barns and sheds. A male trapped by W. J. Millsaps on February 15, 1910, at Soddy, Hamilton County, is the sole record for the State.

Hamilton County: Soddy, 1.

RATTUS NORVEGICUS (Erxleben): Norway, Brown, or Barn Rat

The Norway rat is a destructive pest in most of the larger cities of Tennessee. Although it shows a decided preference for buildings in towns, it is frequently found around farm sheds in which stores of feed or grain are kept. This rat also digs burrows in the banks of farm ditches and streams and is found along marshy areas bordering cultivated fields. One specimen was trapped, according to Komarek and Komarek (1938, p. 159), at an elevation of about 3,800 feet on Eagle Rocks Prong of Little Pigeon River, and another at Greenbrier, Sevier County.

MUS MUSCULUS MUSCULUS (Linnaeus): House Mouse

The house mouse, a native of Europe, appears to be abundant and generally distributed throughout the State. As its name implies it shows some preference for buildings, but it occurs also in the wild state in abandoned and cultivated fields. Perrygo and Lingebach trapped this mouse in cotton-rat runways in broomsedge and weeds bordering a cottonfield on the edge of the cypress swamp near Hickory Withe, at least half a mile from the nearest house. Near Pikeville one was caught in runways in weeds and matted grass on the edge of a cloverfield. Another mouse was caught in cotton-rat runways in an abandoned field overgrown with broomsedge 6 miles east of Pulaski. At Shady Valley four were trapped in grass and weeds around the edge of a wheatfield, quarter of a mile from the nearest buildings. Two were trapped in moss in hemlock woods at an elevation of 2,700 feet at the base of the northwest slope of Low Gap, 4½ miles southeast of Cosby. Three specimens taken at Greenbrier, Sevier County, are listed by Komarek and Komarek (1938, p. 159). Rhoads (1896, p. 192) reports that he had specimens of house mice from Raleigh, Shelby County, and Roan Mountain.

Benton County: Big Sandy, 2.
Bledsoe County: Pikeville, 2 miles north, 1.
Cocke County: Low Gap, 4½ miles southeast of Cosby, 2.
Fayette County: Hickory Withe, 2.
Giles County: 6 miles east of Pulaski, 1.
Johnson County: Shady Valley, altitude 2,900 feet, 4.

Family ZAPODIDAE

ZAPUS HUDSONIUS AMERICANUS (Barton): Carolinian Jumping Mouse

This jumping mouse has been taken in the mountains of western North Carolina within the limits of Great Smoky Mountains National Park. Arthur Stupka, park naturalist, lent a male found hibernating November 7, 1935, by Granville Calhoun on Noland Creek, altitude 2,800 feet, Swain County, N. C. The measurements of this specimen are as follows: Total length, 190.5; tail, 114.3; hind foot, 31.75.

NAPAEOZAPUS INSIGNIS ROANENSIS (Preble): Roan Mountain Woodland Jumping Mouse

The woodland jumping mouse is found most frequently in dense woods with little or no underbrush, usually near streams. A. H. Howell trapped two of these mice at Indian Gap. Perrygo and Lingebach caught one on a rotten log in open hemlock timber with dense crown on the west slope of Low Gap, 4½ miles southeast of

Cosby. Woodland jumping mice were trapped by Komarek and Komarek (1938, p. 160) in the humid forest along Eagle Rocks Prong of Little Pigeon River, Sevier County. The measurements of the three females listed below are, respectively: Total length, 185, 221, 233; tail, 120, 133, 142; hind foot, 29, 29, 29.

Cocke County: Low Gap, 4½ miles southeast of Cosby, altitude 2,700 feet, 1.
Sevier County: Indian Gap, altitude 5,200 feet, 2.

Family ERETHIZONTIDAE

ERETHIZON DORSATUM DORSATUM (Linnaeus): American Porcupine

No mention of the porcupine within the State of Tennessee has been found in the accounts of early explorers. Mercer (1897, pp. 42, 58, fig. 2), however, found the dried feces and quills of a porcupine in Bigbone Cave near Elroy, Van Buren County, Tenn. During the recent rearrangement of the mammal collection in the National Museum, a left mandible of an immature porcupine labeled as coming from a "Tennessee cave," but with no other data, was found.

Family LEPORIDAE

LEPUS AMERICANUS VIRGINIANUS Harlan: Virginia Varying Hare

Information received from local residents suggests that varying hares were formerly present in the mountainous district extending from Mount Guyot to White Rock, Cocke County. These residents inquired if Perrygo had seen any of the rabbits that turned white in winter and made such long jumps when chased in the snow by dogs. He was told that they were usually "jumped" from rhododendron thickets near the summits of the peaks. From repeated inquiries, Perrygo learned that these rabbits were very rare now but formerly were often seen during winter months by local hunters.

SYLVILAGUS FLORIDANUS MALLURUS (Thomas): Eastern Cottontail

The eastern cottontail ranges westward into the valleys, foothills, and even the higher mountain slopes of eastern Tennessee. It is abundant and generally distributed over most of middle and western Tennessee and occurs along some of the smaller tributaries of the upper Cumberland River drainage area. It is most abundant in abandoned farm fields overgrown with broomsedge, weeds, and brush, brier patches, and the thickets bordering deciduous woods and small streams. Although largely nocturnal, when routed during the day from their "form" in some tussock or grass and clump of weeds these rabbits run with surprising speed, twisting and doubling across the field or thicket until they reach shelter in a thicket or hollow log.

One of these cottontails was collected by Perrygo and Lingebach at the edge of a hemlock bog behind the camp at Shady Valley. At an elevation of 2,700 feet on the west slope of Low Gap, 4½ miles southeast of Cosby, one was shot in a rhododendron thicket in hemlock woods. A cottontail with short ears, but with pelage coloration and skull similar to that of *mallurus*, was caught at an elevation of 6,300 feet on Roan Mountain in a large-size Schuyler trap set by Perrygo and Schaefer in a rhododendron thicket in a balsam-fir forest. Cottontails were reported as numerous in the open woods and broomsedge fields near Greenbrier, Sevier County, and 14 were collected by Komarek and Komarek (1938, p. 160).

Writing in 1896, Rhoads (p. 182) stated that this cottontail was so abundant in the woods and thickets bordering the canebrakes along the Mississippi River that it had almost become a nuisance. Near Brownsville, Haywood County, B. C. Miles wrote Rhoads that cottontails had doubled in numbers during the preceding 20 years and that he could recall parties of hunters that had killed 100 in a single day's hunt during February 1895. In the vicinity of Hickory Withe, Arlington, Eads, and Hornbeak, in the western part of the State, these cottontails were taken in broomsedge and brier patches on abandoned fields. At Crab Orchard cottontails were found in laurel thickets in deciduous woods. One cottontail was collected north of Indian Mound in dense deciduous woods with relatively little underbrush. Bangs (1894, p. 409) records three specimens from Trenton, Gibson County. Specimens from Samburg, Obion County, and Raleigh, Shelby County, are listed by Rhoads (1896, p. 183).

Nelson (1909, pp. 174–176) referred specimens taken at Arlington, Big Sandy, and Danville during June 1892 to *S. f. alacer*. All these have a much richer suffusion of rusty reddish over the entire upper parts, the obliteration of the grayish rump patch, and decidedly rusty legs. Nevertheless, all the cottontails in the collection received since 1900 have a somewhat different general coloration, being much lighter and more grayish buff. Howell (1921, p. 70), on the basis of more abundant material than that at the disposal of Nelson, assigned the form ranging through the South Atlantic States to *S. f. mallurus* and remarked that "they agree very closely with this race in color and differ only in having slightly smaller audital bullae." The series of cottontails from Tennessee is quite unsatisfactory, inasmuch as relatively few of the specimens have the fresh fall pelage. It is likely that a more adequate series will show that cottontails from the eastern mountainous portion of the State should be referred to *mallurus* and that those occurring in middle and western Tennessee are either *mearnsi* or intermediates between *mallurus* and *mearnsi*.

Benton County: Big Sandy, 2.
Campbell County: Highcliff, 1.
Carter County: Watauga Valley, 2; Roan Mountain, altitude 6,300 feet, 1.
Cocke County: Low Gap, 4½ miles southeast of Cosby, altitude 2,700 feet, 2.
Cumberland County: Crab Orchard, 1.
Fayette County: Hickory Withe, 1.
Hamilton County: Walden Ridge, near Soddy, 1.
Houston County: Danville, 1.
Humphreys County: South of Johnsonville, 2.
Johnson County: Shady Valley, altitude 2,900 feet, 1.
Knox County: Knoxville, 1.
Obion County: Hornbeak, 1.
Shelby County: Arlington, 2; Eads, 1.
Stewart County: 8 miles north of Indian Mound, 1.
Sullivan County: Holston Mountains, head of Fishdam Creek, 1.

SYLVILAGUS TRANSITIONALIS (Bangs): New England Cottontail

No specimens of the New England cottontail taken in the State are listed by Nelson (1909, p. 199). Regarding its possible occurrence in the Great Smoky Mountains, Bangs wrote Rhoads (1896, p. 183) that he had "examined a large series last winter from Roan Mountain, and they were all true *sylvaticus*" [=*Sylvilagus floridanus mallurus*]. Inasmuch as Howell (1921, p. 71) has taken this cottontail at three localities in northeastern Alabama and has recorded its occurrence at Brasstown Bald Mountain in Georgia, more intensive field work should reveal its presence at localities other than those listed below in the Great Smoky Mountains of eastern Tennessee.

Cocke County: Low Gap, 4½ miles southeast of Cosby, altitude 3,300 feet, 1.
Hamilton County: Walden Ridge, near Soddy, 1.

SYLVILAGUS AQUATICUS AQUATICUS (Bachman): Swamp Rabbit

The swamp rabbit lives in the canebrakes and deep woods along the Mississippi River and is found elsewhere in the State in the swamps and wet bottoms bordering the Tennessee River. Rhoads (1896, pp. 181–182), after having observed this rabbit on the borders of Reelfoot Lake, writes as follows: "It preferred hiding among the half submerged vegetation and piles of driftwood, and when it broke cover would run with bold, high leaps from log to log for so great a distance that it was difficult to find it again." I have observed in southeastern Kansas that this rabbit will take to water as readily as a raccoon. Rhoads (1896, p. 182) lists one specimen from Samburg, Obion County. Perrygo and Lingebach took a male in the cypress swamp bordering Reelfoot Lake, 5 miles west of Hornbeak. On Caney Island, Reelfoot Lake, two were seen in a tangle of pea vines, fallen logs, and cypress trees. Two were seen in another cypress swamp bordering Reelfoot Lake, 2 miles east of Phillippy. All these

swamp rabbits made for the edge of the lake when routed from their "forms."

A. H. Howell (1909, p. 64) states that swamp rabbits "were reported to be found sparingly at Henryville," Lawrence County, "probably ranging up Buffalo Creek from the Tennessee River." Perrygo thought he recognized a swamp rabbit in the cypress swamp near Hickory Withe.

Obion County: Reelfoot Lake, 5 miles west of Hornbeak, 1; Reelfoot Lake, 2 miles southwest of Samburg, 1.

Family SUIDAE

SUS SCROFA SCROFA Linnaeus: Wild Boar

In the spring of 1912, a stock of 15 wild swine of both sexes, which had been captured in northern Germany, probably in the Harz Mountains, was purchased by a group of English sportsmen and liberated in an enclosure near Hooper Bald, N. C. According to Stegeman (1938, p. 280), this original stock was not disturbed for 8 or 10 years. In 1920, however, when an attempt was made to hunt the animals within the enclosure, about 100 broke through the fence and escaped into the mountains. Stegeman reports that wild boars increased in numbers on the Cherokee National Forest notwithstanding the fact that they were freely hunted by natives with dogs until the outbreak of an epidemic of hog cholera in 1932. It is estimated by Stegeman that there are now some 115 wild boars distributed over an area exceeding 50 square miles.

So far as known to Arthur Stupka, park naturalist, no wild boars have come into the Great Smoky Mountains National Park. He believes that the Little Tennessee River, which separates the park from the Cherokee National Forest, may constitute a real barrier against the northward spread of this introduced species.

Family CERVIDAE

ODOCOILEUS VIRGINIANUS VIRGINIANUS (Boddaert): Virginia Deer

The former abundance of deer in all parts of Tennessee is attested by records left by the early traders, hunters, settlers, and travelers. For many years deer skins constituted an important item in the trade. When dressed they were made into vests, pants, and shirts and also the fringed hunting shirts and leggings. Under the act of March 31, 1785, the General Assembly of the State of Franklin fixed the value of "deer skins, the pattern" at 6 shillings (Ramsey, 1853, p. 297). The same Assembly fixed the salary of the governor, per annum, at 1,000 deer skins and that of the chief justice at 500 deer skins, beginning January 1, 1788 (Williams, 1924, p. 215). Good venison, if

delivered where troops were stationed, was, according to the records of Sumner County, accepted for taxes in 1787 at 9 pence a pound (Putnam, 1859, p. 252).

The first mention of deer in eastern Tennessee seems to be recorded by James Needham (Williams, 1928, p. 27), who traveled in 1673 down the valley bounded by the Holston River and Bays Mountains to the Cherokee Indian town Chota [Monroe County]. From that time onward Virginia and Carolina traders had posts in these Cherokee Indian villages, and large numbers of deer skins and other pelts obtained by barter were transported on pack horses to Charleston and to the Virginia stations.

Lt. Henry Timberlake (Williams, 1927, p. 47) was impressed in December 1761 by the number of deer seen during his trip down the Holston River from Kingsport, Sullivan County, to a large cave below the present site of Three Springs Ford, Hamblen County. Timberlake mentioned that there were an incredible number of deer along the Little Tennessee River near the mouth of Tellico River (Williams, 1927, p. 71).

In Martin Schneider's report (Williams, 1928, p. 253) of his journey to the upper Cherokee towns there appears the statement under date of January 1, 1784, that the traders on the French Broad River had paid one quart of an inferior grade of brandy for two deer skins.

After crossing the Holston River at Stonypoint, Hawkins County, in April 1797, the Duke of Orleans and his party saw deer and wild turkeys (Williams, 1928, p. 435).

In middle Tennessee deer appear to have been even more abundant than in the eastern part of the State. French traders and hunters had posts and station camps on or near the present site of Nashville at least as early as 1714. The "long hunters" of the Carolinas and Virginia did not do much hunting in this general region until 1769. Isaac Bledsoe mentions (Henderson, 1920, p. 125) that during the winter of 1769–70 he shot two deer near the lick that has since been known as Castalian Springs, Sumner County. In 1775, Timothé de Monbreun, a French *voyageur*, had a cabin and depot for deer and buffalo hides and tallow at a mound on the north side of Sulphur Spring branch [Nashville] (Putnam, 1859, p. 65).

When the settlers arrived at the Bluff [Nashville] in 1779–80, deer were plentiful in the vicinity (Ramsey, 1853, p. 206), and large numbers came to the sulphur or salt spring [French Lick] near that settlement. So abundant were deer and buffalo that Col. John Donelson, who settled in 1780 in a tract known as "Clover bottom" a few miles up from the mouth of Stone River [Davidson County], was obliged to keep close watch over his growing corn (Putnam, 1859, p. 622). One party of 20 hunters from Eatons Station [Nashville]

traveled up the Cumberland River in canoes to the region between Caney Fork and Flynns Lick Creek [Smith, Putnam, and Jackson Counties], where they killed more than 80 deer during the winter of 1782 (Ramsey, 1853, p. 450). Deer were likewise plentiful along the wagon road between Clinch River and Nashville when it was opened in 1783 (Ramsey, 1853, p. 501).

John Lipscomb (Williams, 1928, p. 277) reports that he saw several deer on July 1, 1784, in Macon County.

Deer were listed by André Michaux (Williams, 1928, p. 335) as being present in the vicinity of Nashville in 1795. Abraham Steiner and Christian Frederic de Schweinitz, after arriving at Camp Station [Sumner County] on their journey from Nashville to Knoxville, noted in their journal (Williams, 1928, p. 516) on December 8, 1799, that deer were present in the Cumberland settlements in the vicinity of Nashville. These same travelers refer (Williams, 1928, p. 519) to the great number of deer in the wilderness near the Caney Fork road [Smith or Putnam County]. Deer appear to have been plentiful in the region of the Cumberland settlements for many years. Putnam, writing in 1859 (p. 127), mentions that 200 deer were then kept in a woodland tract of several thousand acres at Belle Meade [Davidson County].

Relatively few records are available for the region around Chattanooga before 1800. During the Chickamauga expedition commanded by Evan Shelby, one party of troops in 1779 captured a great quantity of deer skins owned by the trader McDonald at Little Owl's town on the Tennessee River (Ramsey, 1853, p. 188). Francis Baily (Williams, 1928, p. 402) while traveling during July 1797 through the wilderness east of the Tennessee River reported that deer were plentiful in the region between Muscle Shoals and Duck River.

Western Tennessee was visited by traders from the Carolinas before 1700. According to Williams (1928, p. 94) several were with the Chickasaw Indians in 1699, trading for toe-buckskins and Indian slaves. Father James Gravier mentions (Williams, 1928, p. 69) that his party killed four does on October 25, 1700, near the present site of Memphis.

Forked Deer River, which separates Dyer and Lauderdale Counties, received its name from a buck with peculiar antlers that was killed in 1785 by a surveying party organized by James Robertson, Henry Rutherford, and Edward Harris (Williams, 1930, p. 43). This party depended for subsistence on deer, elk, and bears, while surveying in Lauderdale County.

According to S. C. Williams (1930, p. 180) an English visitor, S. A. Farrell, described the deer hunts in the vicinity of Memphis in 1830 as follows: Hunting was done on horseback with dogs. When the dogs came on fresh deer tracks, the hunters were posted and

then three persons set forward with the dogs, always following the deer against the wind. When the deer was started, the hunters fired as he passed their posts.

Obion County, according to Williams (1930, p. 153), longer than any other, remained a good hunting ground for deer. Hallock, writing in 1877 (pp. 152–153), states that deer were then hunted around Reelfoot Lake, Obion County, and in the vicinity of Trimble, Dyer County, that there were deer near Hales Point, Lauderdale County, and that deer afforded good sport in the canebrakes below Memphis, Shelby County. He also says that deer were then found in abundance along the Cumberland River, Davidson County, in the mountains in the vicinity of Sewanee, Franklin County, and also in the mountains in the vicinity of Wauhatchie and Chattanooga, Hamilton County.

During the following 15 years, the number of deer was markedly reduced in many of these areas. A. B. Wingfield (1895, p. 515) states that "the Cumberland Mountain range has been almost entirely depleted of its stock of deer" and that 248 carcasses of deer were shipped from Crossville, Cumberland County, during 1894. The Tennessee State Legislature in 1895 passed a law prohibiting the killing of deer for 5 years in Cumberland, Claiborne, Scott, Morgan, and Anderson Counties. Rhoads (1896, p. 180) was told that there were then about 20 deer in Haywood County.

Komarek and Komarek (1938, p. 161) report that several deer were seen near Cades Cove, Blount County, and also near Cosby, Cocke County, and that until hunting was prohibited with the establishment of the Great Smoky Mountains National Park, several were taken each year in the Butler Tract near Gregory Bald, Blount County.

CERVUS CANADENSIS CANADENSIS Erxleben: Eastern Elk, or Wapiti

Curiously enough, although there are numerous references to other kinds of game, only incidental reference is made to elk in the accounts left by early hunters, settlers, and travelers.

James Needham, who was sent in 1673 on a trading expedition to the Cherokee towns in southeastern Tennessee, wrote in his journal (Williams, 1928, p. 27) that while traveling down the valley bounded by the Holston River and Bays Mountains, he observed a "great store of game, all along as turkes, deere, elkes, beare, woolfe and other vermin."

Ramsey (1853, p. 206) remarks that when the settlers arrived at the Bluff [Nashville] in 1779–80, the surrounding region was "one large plain of woods and cane, frequented by buffaloes, elk, deer, wolves, foxes and panthers." Putnam (1859, p. 81) likewise states that "innumerable herds of buffalo, deer and elk came to the "sul-

phur or salt spring at Nashville. During 1783 when the road was opened from Clinch River to Nashville by way of Crab Orchard [Cumberland County] it passed through "vast upland prairie, covered with a most luxuriant growth of native grasses, pastured over as far as the eye could see, with numerous herds of deer, elk, and buffalo" (Ramsey, 1853, p. 501).

Lewis Brantz, who had been sent out by the merchants of Baltimore, departed from Nashville on December 28, 1785, and traveled with a pack horse 140 miles through the barrens to the Holston River settlements. He noted in his journal (Williams, 1928, p. 286) that while enroute he saw but one elk, although he observed large numbers of antlers.

Henry Rutherford and his guide, while surveying a large tract of land in 1785 on the south side of the Forked Deer River, Lauderdale County, killed elk and other game for food (Williams, 1930, p. 44).

André Michaux, while residing at Nashville, noted in his journal under date of June 21, 1795, that elk were present in that region (Williams, 1928, p. 335).

Putnam (1859, p. 127) states that half a dozen elk were kept in 1859 in a private woodland tract at Belle Meade, or Dunhams Station.

Elk at one time were plentiful in most parts of Tennessee, occurring not only in the high passes and narrow valleys of the mountainous sections but also in association with the buffalo visited the licks of middle Tennessee, browsed along the rivers and creeks in the southern counties, and wandered through the canebrakes of the Mississippi bottomlands.

When the early hunters and settlers first set foot in eastern Tennessee, there were many large tracts covered with native grasses on the low hills and narrow valleys of the southern Allegheny Mountains that afforded pasture lands for herds of elk and in the summer for buffalo (Ramsey, 1853, p. 96).

David Crockett (1834) in his autobiographical sketch repeatedly refers to elk in the bottomlands of Obion and Dyer Counties in the decade between 1820 and 1830.

According to B. C. Miles (Rhoads, 1896, p. 181) an elk was killed by David Merriwether about 1849 at Reelfoot Lake, and another was reported to have been killed in Obion County in 1865.

Under the pen name "Antler" (1880, p. 306) a resident of Piney Creek Falls, Van Buren County, wrote in 1880 as follows: The Caney Fork district "embracing the tributaries of the Caney Fork, remains a wilderness still. The surface is rough and broken. Deer and wild turkeys are found here in moderate numbers, with a few bears, and occasionally some gray wolves are found; but the oldest mountaineer can not remember back to the time when elk and buffalo roamed

through these forests." This report seems to indicate that elk were exterminated on the Cumberland Plateau early in the nineteenth century.

Family BOVIDAE

BISON BISON PENNSYLVANICUS Shoemaker: Eastern Woodland Bison

Bison once roamed in large numbers over some parts of Tennessee, but so far as known not a single skull from a Tennessee locality can be found now in any of the larger museums. All the early explorers followed buffalo trails through the wilderness, and the Spanish and French settlements relied to some extent on the buffalo for meat.

J. A. Allen (1876, p. 102), after commenting on the former abundance of bison in the region around Nashville, concluded that they probably ranged southward to the Tennessee River, since a stream called Buffalo River forms one of the larger tributaries of Duck River. As will be shown hereinafter, bison formerly ranged southward to below Memphis in the western part of the State and at least to Monroe County in eastern Tennessee.

James Needham, who was sent by Abraham Wood (Williams, 1928, p. 28) on a trading expedition, in relating his experiences in 1673 at the Cherokee Indian town Chota [located on the south side of the Little Tennessee River a short distance below Citico Creek, Monroe County] remarked that "many hornes like bulls hornes lye upon theire dunghills." There is at least one bit of evidence to show that the buffalo may have ranged farther south than Monroe County. The left mandible of an immature buffalo (U.S.N.M. no. 200148) was found in 1914–15 by Clarence B. Moore (1915, p. 368) in an aboriginal burial mound at Hampton Place on the Tennessee River opposite Moccasin Bend, Hamilton County. There are other records showing that buffaloes were found before 1700 much farther south than the southern boundary of eastern Tennessee. Boyd (1936, p. 203), quoting from old Spanish documents relating to the expedition of Marcos Delgado from Apalachee to the Creek country in 1686, has shown that this Spaniard saw buffaloes near Russ Creek and northwest of Marianna, Jackson County, Fla., and near the Little Choctawhatchee River, Houston County, in the southeastern corner of Alabama.

On March 30, 1750, Dr. Thomas Walker (Williams, 1928, p. 170) caught two young buffaloes on Reedy Creek and then traveled down this creek to Long Island, Holston River [Kingsport, Sullivan County].

On the trip during December 1761 down the Holston River from Kingsport, Sullivan County, to a large cave below the present site of Three Springs Ford, Hamblen County, Lt. Henry Timberlake

wrote in his memoirs (Williams, 1927, p. 47) that "nothing more remarkable occurred, unless I mark for such the amazing quantity of buffaloes, bears, deer, and beavers." In another entry in his memoir (Williams, 1927, p. 71) Timberlake wrote on January 2, 1762, while residing near the mouth of Tellico River, that "there are likewise an incredible number of buffaloes." Again after crossing the French Broad River enroute to Great Island [Kingsport, Sullivan County] along the Great Path, he wrote on March 15, 1762, that 17 or 18 buffaloes ran among the party (Williams, 1927, p. 120).

The settlers in Carters Valley, Hawkins County, during the winter of 1776 killed bison 12 to 15 miles northwest of the settlement (Ramsey, 1853, p. 144).

From these sources we observe that bison formerly passed over the Cumberland Gap into Tennessee along the Holston, Clinch, and Powell River Valleys. The number of buffalo in eastern Tennessee, judged from the records, was never very large.

By far the larger number of bison occurred in the vicinity of the Cumberland River and its tributaries in middle Tennessee. It will be recalled that French *voyageurs* had been hunting and trading in that region for more than 75 years before the establishment of the Nashville settlement, killing buffaloes mainly for tongues and tallow, and to a less extent for hides. M. Charleville, a French trader and hunter from Crozat's colony at New Orleans, came upon the Shawnees then inhabiting the Cumberland region and built a post in 1714 on a mound near the present site of Nashville on the west side of the Cumberland River, near French Lick Creek, and about 70 yards from each stream (Ramsey, 1853, p. 45). Subsequently other French hunters and trappers from Illinois and New Orleans camped in the same region.

In 1769, Isaac Bledsoe and Kasper Manscoe [sometimes Gasper Mansker] established camp on Station Camp Creek in Sumner County. From that camp each of these men followed in opposite directions the nearby buffalo trail, one finding the salt licks since known as Bledsoes Lick and the other Manscoes Lick. On the 100-acre surrounding flat, Bledsoe saw thousands of bison (Henderson, 1920, p. 125). This lick is now known as Castalian Springs, Sumner County.

In 1770, Manscoe, Uriah Stone, and eight others hunted at French Lick [Nashville], where they found immense numbers of bison and other wild game (Ramsey, 1853, p. 105). Captain Timothé de Monbreun, a French *voyageur* from Illinois, who as late as 1823 lived at Nashville, hunted in that vicinity in 1775. During that summer Monbreun and one companion had a camp at a site since

known as Eatons Station [Nashville]. An enormous number of buffaloes were killed by these French hunters, but only the tallow and the tongues were saved. These were taken down the Cumberland River in a keel boat (Ramsey, 1853, p. 192; Henderson, 1920, p. 128). For more than a decade Monbreun hunted in this general district, and it is quite likely that his or some other party of French hunters was responsible for the slaughter of buffaloes at Bledsoes Lick in Sumner County, which Isaac Bledsoe related to an early settler, William Hall. According to the latter (Henderson, 1920, pp. 128–129), "one could walk for several hundred yards a round the Lick and in the Lick on buffelows skuls, & bones, and the whole flat round the Lick was bleached with buffelows bones, and they found out the Cause of the Canes growing up so suddenly a few miles around the Lick which was in consequence of so many buffelows being killed."

In February 1777, de Monbreun arrived at Deacons Pond [near Palmyra, Montgomery County], where he met a party of six white men and one woman who had traveled by boat down the Cumberland River from a point near the mouth of Rockcastle River [Laurel County, Ky.]. This party reported that they had seen immense herds of buffaloes on this trip (Ramsey, 1853, p. 193).

When the first settlers arrived at Nashville in 1780, bison were still present in the surrounding country (Ramsey, 1853, p. 206). Col. John Donelson's party killed buffaloes along the Cumberland River near the Kentucky-Tennessee line on March 30, 1780 (Williams, 1928, p. 241). When Colonel Donelson settled in 1780 a few miles up from the mouth of Stones River [Davidson County], in a tract called "Clover Bottom" and planted his corn, there were "immense herds of buffalo, deer, etc., ranging through these forests" (Putnam, 1859, p. 622).

According to Ramsey (1853, p. 450) a party of 20 hunters from Eatons Station [Nashville] traveled up the Cumberland River in canoes to the region between Caney Fork and Flynns Lick Creek [Smith, Putnam, and Jackson Counties], where they killed 75 buffaloes during the winter of 1782.

When the road from Clinch River to Nashville by way of Crab Orchard [Cumberland County] was opened in 1783, the top of the mountain was described as a "vast upland prairie, covered with a most luxuriant growth of native grasses, pastured over as far as the eye could see, with numerous herds of deer, elk and buffalo" (Ramsey, 1853, p. 501).

John Lipscomb wrote in his journal (Williams, 1928, p. 276) under date of June 29, 1784, that having come to the lick near Little Barren River [Macon County, Tenn., or Allen County, Ky.], they "crept to

the Lick where we found there had been great slaughter made amongst the buffelow; we had not been there long before we saw two big buffelow bulls coming toward us accompanyed with a wolf." Again on August 7, 1784, John Lipscomb's party (Williams, 1928, p. 278) reached Red River Station, and then traveled through the barrens, where they saw a "gang of buffaloes" [Sumner County].

After leaving Nashville on December 28, 1785, enroute to Holston River, Lewis Brantz (Williams, 1928, p. 286) traveled with a pack horse 140 miles through the barrens where nothing but grass grows. Brantz remarked that the buffaloes had been considerably hunted by the woodsmen and were diminished in number. The first records of Sumner County show that "prime buffalo beef" was accepted for taxes in 1787 at 3 pence a pound, if delivered where troops were stationed (Putnam, 1859, p. 252). Bison apparently were still to be found in Montgomery County in 1793. Goodpasture (1903, p. 206) has published a contract signed October 4, 1793, by John Dier for delivery of 35 hundredweight of buffalo beef to John Edmonson, at $2 a hundred.

André Michaux (Williams, 1928, p. 335) listed buffaloes as being present in June 1795 in the region around Nashville. Abraham Steiner and Christian Frederic de Schweinitz in December 1799 reported that bison were still present near the Caney Fork Road [Putnam County] but were "rarely killed by the hunters, as they are shy and fleet and do not usually fall at the first shot" (Williams, 1928, p. 519). Writing in 1859, Putnam (p. 127) stated that a woodland tract of several hundred acres at Belle Meade [Dunhams Station] belonging to Gen. William G. Harding was stocked at that time with 200 deer, 20 buffaloes, and half a dozen elk. In 1916 Clarence B. Moore excavated a left metacarpal (3+4) and two phalanges (U.S. N.M. no. 216652) from a mound at Hales Point, Lauderdale County.

While collecting in Tennessee, Rhoads (1896, p. 179) received information from local residents that the last buffalo in Fentress County was killed by John Young, but the date was not obtained.

Bison were once present in some numbers in western Tennessee along the Mississippi River. From the journal of Diron d'Artaguette, inspector-general under the Duke of Orleans, we get our first information as to the former presence of great herds of bison in west Tennessee. Traveling up the Mississippi River in March 1723, he saw bison at many places on both sides of the river. It is recorded in his journal (Williams, 1930, p. 10) that a buffalo cow was killed near Wolf River, Shelby County. As he continued on this journey upstream, many buffalo were killed before he passed the present boundaries of Tennessee.

In the course of his journey down the Mississippi River during November 1766, George Morgan (Williams, 1928, pp. 216–218) passed a number of French hunting parties who had ascended the river from New Orleans to kill buffaloes and bears. Along the eastern shore between the mouth of Hatchie River above Prud'homme Cliff and the present site of Memphis, 10 French hunting parties were seen. Again in June 1768, John Jenning saw French hunters on both sides of the Mississippi River in the same region (Williams, 1928, p. 221).

In 1819, Williams (1930, p. 96) states, the "buffalo, once numerous, had disappeared" in west Tennessee. Haywood, writing in 1823 (p. 234), confirms this and says that "at this time there is not one in the whole State of Tennessee."

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SPECIES OF THE FORAMINIFERAL FAMILY CAMERINIDAE IN THE TERTIARY AND CRETACEOUS OF MEXICO

By R. Wright Barker

During my work as micropaleontologist in Mexico, I have met with many species of Camerinidae, but in many cases, owing to inadequate literature available on the American species of the family, I have deferred identification of them. During the past few years this has resulted in the accumulation of many species with only tentative identifications and in many manuscript names of species believed to be new.

Recently it became possible to carry out research on the collection, and I made and photographed large numbers of sections. I wish to express my thanks to the Compañia Mexicana de Petroleo "El Aquila," S. A., and to the Bataafsche Petroleum Maatschappij for permission to publish material that originally formed part of confidential reports; and also to numerous individuals from whom help and advice were received. Among these must be mentioned especially Thomas F. Grimsdale, who assisted in sectioning and photographing the specimens, and Dr. T. Wayland Vaughan, who gave helpful criticism and supplied comparative material. Mrs. R. H. Palmer furnished valuable samples from Cuba; Dr. Lloyd G. Henbest kindly sent topotype material from the United States National Museum; and J. B. Garrett sent further specimens. To all these workers I am especially grateful, as correctly named material is essential in the study of any of the so-called "larger Foraminifera," particularly the Camerinidae, which do not lend themselves to detailed diagnosis as

do most of the other groups, and moreover they have frequently suffered in the past from very inadequate descriptions and figures.

STRATIGRAPHY

John M. Muir (1936) has recently published an excellent account of the stratigraphy of the area in which the present collections were made, and he clearly differentiates the various horizons. I have been accustomed, in common with many workers in Mexico, to a slightly different nomenclature, such as Alazan in place of Huasteca formation, Cole's Guayabal in place of ver Wiebe's Tempoal, and Velasco rather than Tamesi. Though there is little doubt as to the soundness of Muir's reasons for changing the nomenclature, both systems are given in the present account since the ages of the beds containing the species described were determined by means of the smaller Foraminifera as described by Nuttall (1932) in his account of the Upper and Lower Alazan and by W. Storrs Cole (1927, 1928) in his papers on the Chapapote and Guayabal. As there is some doubt as to the exact equivalence of the Huasteca to the Alazan as understood by Nuttall and also a possibility that the Guayabal of Cole represents a higher horizon than ver Wiebe's Tempoal (as exposed at the type localities of these formations), it has been thought better to give the older nomenclature and, in parentheses, what is considered to be the equivalent horizon of Muir.

The nomenclature alternative to that of Muir may be found in a recent publication of the writer (Barker, 1936).

PREVIOUS PUBLISHED WORK

Beginning with Cushman's monograph, "American Species of *Operculina* and *Heterostegina*" in 1921, a large number of species referred to *Operculina* and *Nummulites* have been described from the New World, though it had long been denied that true *Nummulites* existed there. The greater number of species have been contributed by Cushman, the elder and younger Rutten, Willard Berry, Mrs. Palmer, W. Storrs Cole, Dr. Vaughan, and Gravell and Hanna. The species of both L. and M. G. Rutten are in general well described, with fairly adequate illustrations; those of Cushman are very incompletely described, and in many cases sections either are not illustrated or are so badly illustrated as to be of little value; the work of Willard Berry is similar to his work on the Peruvian species of *Lepidocyclina* and may be neglected in the present résumé. Of most importance is a recent account by Dr. T. Wayland Vaughan and W. Storrs Cole (1936) entitled "New Tertiary Foraminifera of the Genera *Operculina* and *Operculinoides* from North America

and the West Indies," in which some new Mexican forms, hitherto unpublished, are described and figured. I have traced 50 recognized species of the genera *Nummulites* (*Camerina*), *Operculinella*, and *Operculinoides* described from the Americas, but it is not considered necessary to list these here, beyond stating that careful comparison has been made in the case of all Mexican forms with those previously found in the New World.

CLASSIFICATION

The Camerinidae possess the most extensive literature of any group of Foraminifera, so it is not proposed to give here long bibliographic lists, but only the more important references to American species.

The question of nomenclature is a difficult one, the accepted custom being to follow d'Orbigny in allotting the various species to the genera *Nummulites* (*Camerina* of Bruguière), *Operculina*, and *Assilina*, with the addition of Yabe's genus *Operculinella* for such forms as appear intermediate between *Camerina* and *Operculina*.

The establishment of *Nummulites* or *Camerina* for completely involute forms with lateral spaces between successive laminae, *Operculina* for completely evolute forms, and *Assilina* for forms that are involute but lacking the lateral cavities, the laminae being thin and closely appressed, seems at first to be a simple and clearly defined system of classification. Unfortunately, a certain number of species commence with an involute spire and later open out becoming complanate and evolute. Such forms were included by d'Orbigny and by Brady (see classification of the Nummulinidae in the *Challenger* Report) in *Operculina*, since the definition clearly states that the early whorls may be more or less embracing. Yabe, however, preferred to take such forms out of *Operculina* into a new genus *Operculinella*, producing more confusion, as individual ideas as to the characters of the new genus seem to be greatly varied.

Furthermore, none of the genera satisfactorily fitted the majority of American species, which are thin, of few whorls, complanate, and nearly always completely involute, without lateral cavities. As a result species have been variously attributed to *Camerina*, *Nummulites*, *Assilina*, *Operculinella*, and *Operculina* according to the opinion of each individual author. In 1935 Hanzawa erected the genus *Operculinoides* for the American group of species mentioned above; he refers a number of species to the new genus, on the evidence of actual specimens and on the original figures (Hanzawa, 1935, pp. 16–19) but does not illustrate the new genus, and the description might well be amplified. The genotype is given as *Operculinoides willcoxii* (Heilprin), and most American species formerly considered to belong to *Operculina* are transferred to *Operculinoides*.

The classification of Hanzawa has been adopted by Vaughan and Cole (1936) in the description of a number of new species of *Operculinoides* from North and Central America and the West Indies, and it is also followed herein.

I am not yet convinced as to the advisability of splitting up the group into so many genera, as in all cases forms can be found intergrading from one so-called genus into another. Thus it is often impossible to state with certainty whether a species should be *Operculinella* or *Operculina*, *Operculinoides* or *Camerina*, or even *Operculinoides* or *Operculina* (as in the case of *Operculina tuberculata* Vaughan and Cole), thus leaving much to the discrimination and personal opinions of the individual workers. There is also the problem as to whether the law of priority should be followed for *Camerina*, or the custom of accepted usage involving the use of the term *Nummulites*, to which many of the older workers still adhere. In the present account *Camerina* has been used, in accordance with the classifications of Cushman and Galloway, and the question as to whether the various "genera" could be better considered as subgenera of *Camerina* and *Operculina* has been deferred. I am of the opinion that Hanzawa (1935) rightly abandoned Hofker's theory that all the genera are synonymous with *Camerina*, and until more work has been done on the evolution and phylogeny of the group it seems preferable to adhere to the accepted classification as modified by Hanzawa.

In addition to the genera mentioned above we have two new genera recently erected by Hanzawa (1937), namely *Paraspiroclypeus*, referred to the Camerinidae, and *Pellatispirella*, included with *Pellatispira* in a new family Pellatispiridae. As Hanzawa notes, *Pellatispira* was included by Umbgrove and by Galloway in the Camerinidae, though considered by Cushman as showing more affinities with the Calcarinidae. Hanzawa removes the genera *Pellatispira* and *Pellatispirella* from the Camerinidae on structure of the shell wall and peculiarities of the canal system.

The double nature of the walls, which is well exemplified by *Pellatispirella matleyi* (Vaughan) and most species of *Pellatispira*, is much less marked in *Pellatispirella antillea* Hanzawa and appears to be a variable character. The principal difference between the canal system in the Camerinidae and the Pellatispiridae appears to be the presence of "vertical canals" in the latter. Thus Hanzawa (1937, p. 114) remarks as follows: "Vertical canals are always found in the genera *Calcarina*, *Rotalia*, and *Elphidium*, especially in their umbonal regions, but never in *Camerina*, *Assilina*, *Operculina*, *Heterostegina*, and *Spiroclypeus*."

I am not wholly in agreement with this statement, since vertical canals are seen in transverse sections of *Camerina* figured by Hofker (1927, p. 58) and of *Heterostegina* (1927, pl. 35). Carpenter (1862) mentions the presence of canals in the pillars in *Camerina*, and Möbius (1880, pl. 13) has figured similar canals in *Heterostegina*. In addition I have obtained Canada-balsam preparations of *Camerina variolaria* (Lamarck) that show excellently developed vertical canals in the bosses of clear shell material in the umbonal area; *Heterostegina* also shows vertical canals, and in some sections the aperture is clearly seen to be multiple, along the base of the septa, as described for *Pellatispirella*. The vertical canals are, admittedly, never so well developed in typical Pellatispiridae, but the differences do not seem to me to justify the formation of a new family. The various members of the Camerinidae show wide variation in the form of the canal system, in some cases as great as that shown by *Pellatispirella* from typical *Camerina*, and for these reasons it is proposed that the Pellatispiridae be allowed to remain in the Camerinidae, as a subfamily. The new species *Camerina pellatispiroides* is looked upon as linking the Pellatispiridae with the Camerinidae, since its canal system is closer to the former than to the latter, though the aperture is typical of *Camerina* and there is no sign of the double nature of the walls described for *Pellatispirella*.

DESCRIPTION OF SPECIES

Family CAMERINIDAE Meek and Hayden, 1865

Genus OPERCULINOIDES Hanzawa, 1935

OPERCULINOIDES WILLCOXII (Heilprin)

PLATE 13, FIGURE 3; PLATE 16, FIGURE 1; PLATE 21, FIGURE 13

1882. *Nummulites willcoxii* HEILPRIN, Proc. Nat. Acad. Sci. Philadelphia, vol. 34, p. 191, figs. 1, 2; *ibid.*, vol. 36, pp. 321–322, figs. 1, 2, 1884.

1921. *Operculina willcoxii* (Heilprin) CUSHMAN, U. S. Geol. Surv. Prof. Paper 128-E, p. 129, pl. 20, figs. 9–11.

1928. *Operculinella willcoxii* (Heilprin) VAUGHAN, 19th Ann. Rep. Florida State Geol. Surv., p. 158.

1935. *Operculinoides willcoxii* (Heilprin) HANZAWA, Sci. Rep. Tôhoku Imp. Univ., ser. 2 (Geol.), vol. 18, no. 1, p. 18.

This species has recently been made the genotype of the new genus *Operculinoides* (see Hanzawa above). The Mexican specimens have been compared with specimens from the Gulf coast of the United States and seem essentially the same species. Their description is as follows:

Test large, very compressed, completely involute, the last whorl showing rather clearly on the exterior (after the fashion of *Assilina*). Sutures not clearly visible on the exterior. Diameter, average 5.3 mm,

with an observed maximum of 7.0 mm; thickness, up to 1.0 mm, with an average of between 0.8 and 0.9 mm.

Sections show the coiling to be regular, mature specimens showing 5 to 6 whorls with 37 or 38 chambers in the final one. The septa are thin and slightly sigmoid in shape, recurving sharply toward the periphery. Chambers numerous, rather long in proportion to their width. Transverse sections show that there is a tendency for the outer walls of succeeding coils to become closely appressed, without, however, becoming fused.

Plesiotypes.—U.S.N.M. nos. 497829 and 497830.

Other specimens.—U.S.N.M. nos. 497831 and 497832.

Occurrence.—Common in the Tantoyuca formation, Jackson Eocene.

OPERCULINOIDES NUMMULITIFORMIS (L. Rutten)

PLATE 17, FIGURE 5; PLATE 21, FIGURE 1

1928. *Operculina nummulitiformis* L. RUTTEN, Proc. Sect. Sci. Kon. Akad. Wetensch., Amsterdam, vol. 31, no. 9, p. 941, figs. 1–12.

1932. *Operculina nummulitiformis* L. Rutten, M. G. RUTTEN and VERMUNT, Proc. Sect. Sci. Kon. Akad. Wetensch., Amsterdam, vol. 35, no. 2, p. 239, pl. 1, figs. 7, 10; pl. 2, fig. 1. (Full synonymy given in this account.)

1937. *Operculinella nummulitiformis* (L. Rutten) VAUGHAN, *in* Sheppard's "The Geology of South-Western Ecuador," pp. 159–160, figs. 116 (1–3).

Mexican specimens identified as this species are described as follows:

Test of medium size, very compressed, completely involute. The sutures are strongly beaded and slightly raised, the test being a little thicker in proportion to diameter than in *O. prenummulitiformis.* Diameter, average 3.0 mm; thickness, average 0.5 mm.

Sections show numerous long narrow chambers, the test showing 3½ to 4½ whorls, with 28 to 33 chambers in the final whorl. The septa are rather irregular as shown in Rutten's original figures of *O. nummulitiformis.* The Mexican specimens differ from L. Rutten's original description in that they are slightly thicker (0.5 mm average compared with 0.35–0.45 mm) and from Rutten and Vermunt's description in having beaded sutures in place of a smooth surface. This latter difference may be due, perhaps, to state of preservation and to local variation, as the degree of beading is variable in specimens examined. In other respects the species are remarkably similar, and Rutten and Vermunt's figure (1932, pl. 2, fig. 1) leaves little doubt in my mind that the Mexican specimens should be referred to *O. nummulitiformis.* It seems doubtful whether Vaughan's Ecuadorian material should be referred to this species, since the specimens figured show a more rapidly opening spiral with fewer whorls and fewer chambers in the final whorl in proportion to the size of the

test than is shown in the figures of Rutten or Rutten and Vermunt. The latter authors place *O. atascaderensis* Berry and *O. peruviana* in the synonymy of *O. nummulitiformis*, with which I am in agreement. Thus we have a wide-ranging form occurring in the upper Eocene of Peru, Ecuador, Curaçao, and Mexico.

Plesiotypes.—U.S.N.M. no. 497834.

Other specimens.—U.S.N.M. no. 497833.

Occurrence (in Mexico).—Tantoyuca formation, Jackson Eocene.

OPERCULINOIDES PRENUMMULITIFORMIS, new species

PLATE 12, FIGURES 1, 2; PLATE 17, FIGURE 4; PLATE 21, FIGURE 2

Test of medium size, very compressed, completely involute, the last whorl somewhat thinner than the earlier coils. Sutures are slightly raised, rather limbate, and show a tendency to become beaded, especially toward the center of the test. Diameter, up to 4.0 mm, average 3.25 mm; average thickness, 0.5 mm.

Sections show the test to be composed of 3½ to nearly 4 whorls, with 22 to 27 chambers in the final whorl. The septa are numerous, thin, and uniformly curved throughout their length. The chambers are long and narrow and of even size and shape, in contrast to the irregularities shown by the closely allied form *O. nummulitiformis* (Rutten). Sections also reveal the presence of numerous supplementary or secondary apertures, irregularly distributed along the septa as illustrated by Carpenter ("secondary pores," 1862, p. 254, fig. 12). The exact significance of these has not yet been satisfactorily explained, but they may have been developed in the first place in connection with adaptation to such factors as food supply. As remarked under *O. jennyi*, the development of multiple apertures probably led at a later stage to formation of subsidiary chamberlets, such as are found in *Heterostegina* and *Spiroclypeus*.

Cotypes.—U.S.N.M. nos. 497835 and 497836.

Occurrence.—Guayabal (Tempoal) formation, Claiborne Eocene. Cotypes have been selected from Poza Rica Well no. 8, a further excellent suite of specimens being obtained from core samples of Mecatepec Well no. 6.

OPERCULINOIDES TUXPANENSIS (Thalmann)

PLATE 16, FIGURE 2; PLATE 17, FIGURE 2

1935. *Operculina tuxpanensis* THALMANN, Eclogae geol. Helvetiae, vol. 28, pp. 603–604, figs. a, b (Tuxpam formation, Mexico).

1936. *Operculinoides tuxpanicus* VAUGHAN and COLE, Proc. U. S. Nat. Mus., vol. 83, p. 494, pl. 37, figs. 4–9.

This form, which is of medium size, thin and compressed, and completely involute, is described by Thalmann as having a diameter of 3 to 4 mm; thickness 0.2 to 0.3 mm, and 3½ whorls with 28 to 32 chambers in the last whorl. This, according to Thalmann, is for the microspheric form, though from his figure this is not certain. The surface is smooth in all specimens examined.

Sections made from material collected by Thalmann, near his type locality (various outcrops along the Tuxpam River between Cobos and Tuxpam) show 3 to 3¼ whorls, with 20 to 24 chambers in the final whorl. The coiling is somewhat irregular; the sutures thin, a thick outer wall giving a thickened, rounded periphery; the chambers are numerous, long, and narrow.

Specimens from Biche Quarry, Nariva District, Trinidad, British West Indies (the Guaracara limestone), in the collection of T. F. Grimsdale, are considered to belong to this species. There seems to be no doubt that *Operculinoides tuxpanicus* Vaughan and Cole is a synonym of *Operculina tuxpanensis* Thalmann, though Thalmann undoubtedly had much better material than Vaughan. Various measurements are given below for comparison:

Species	Diameter	Thickness	Number of whorls	Number of chambers in final whorl
	Mm	*Mm*		
Operculina tuxpanensis Thalmann	3–4	0.2–0.3	3½	[1] 28–32
Specimens sectioned by the writer	2.5–3.0	0.3–0.4	3–3½	20–24
Operculinoides tuxpanicus Vaughan and Cole	1.7–3.2	0.3–0.5	3–3½	19–20

[1] Microspheric.

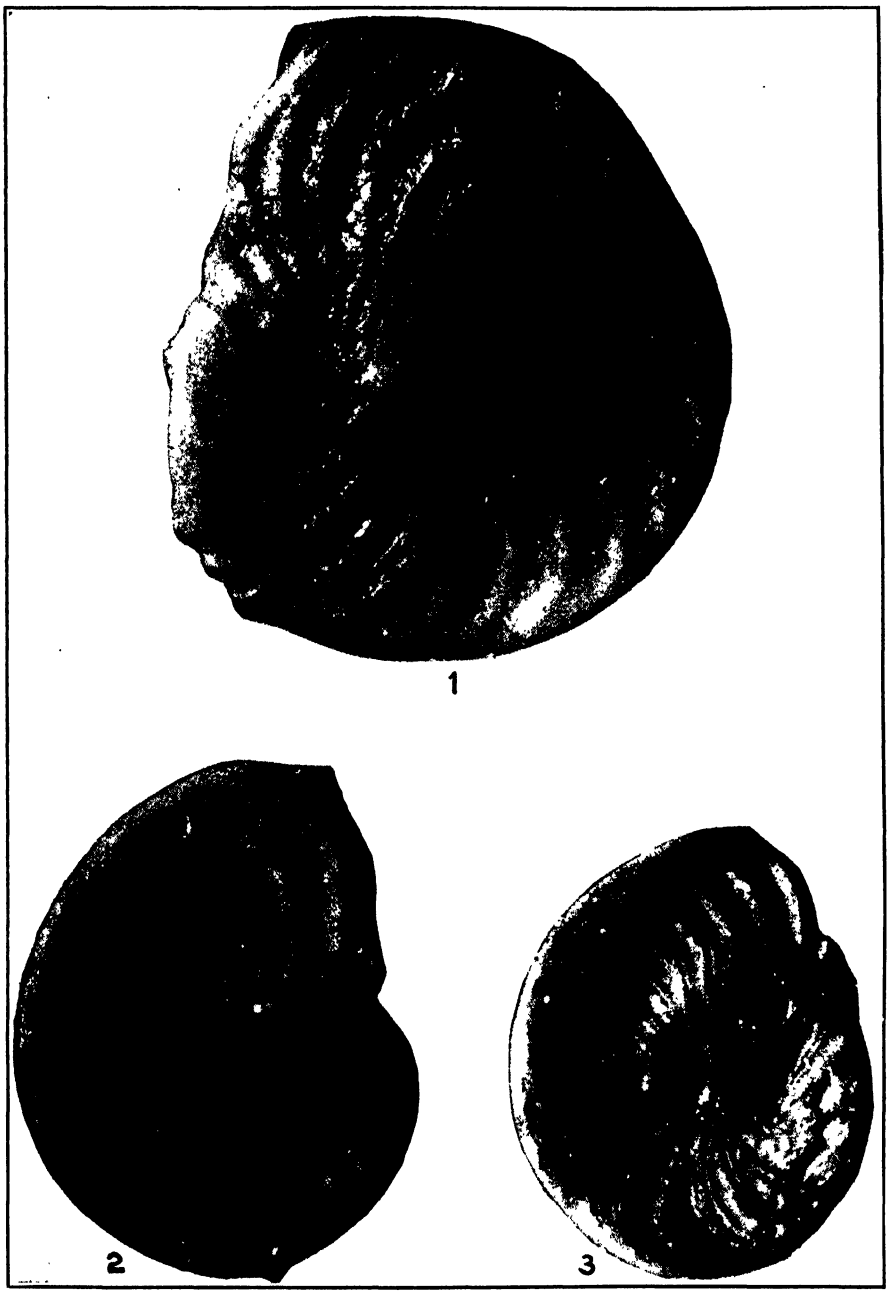
Plesiotypes.—U.S.N.M. no. 497838.
Topotypes (?).—U.S.N.M. no. 497837.
Occurrence.—Tuxpam formation, lower Miocene.

OPERCULINOIDES MUIRI, new species

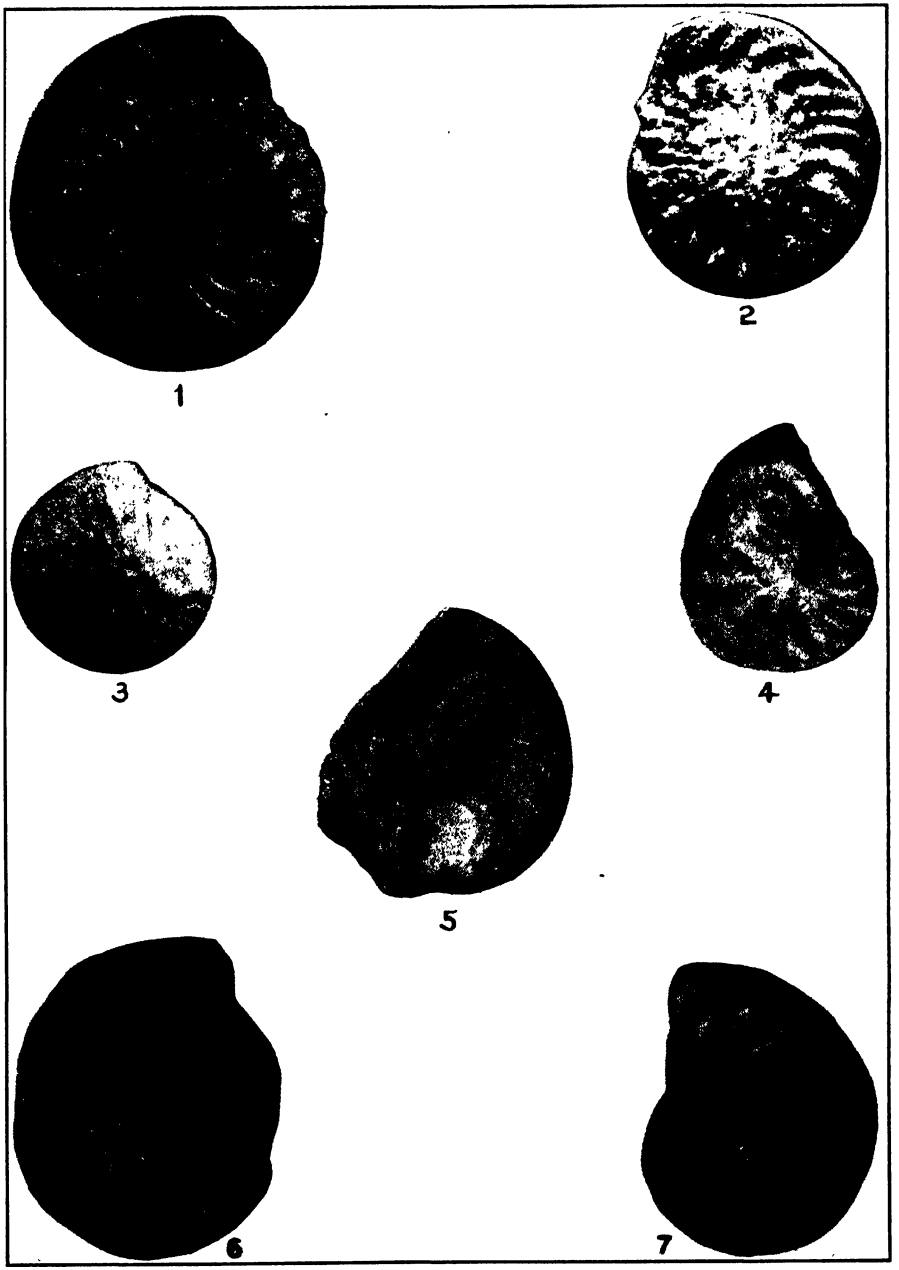
PLATE 14, FIGURE 4; PLATE 20, FIGURE 1; PLATE 22, FIGURE 1

Test small to medium in size, completely involute, lenticular and rather close-coiled, with a fairly well developed, rounded keel of clear shell material. Diameter, up to 3.0 mm (average for 10 specimens, 2.6 mm); thickness, 0.7 to 0.9 mm.

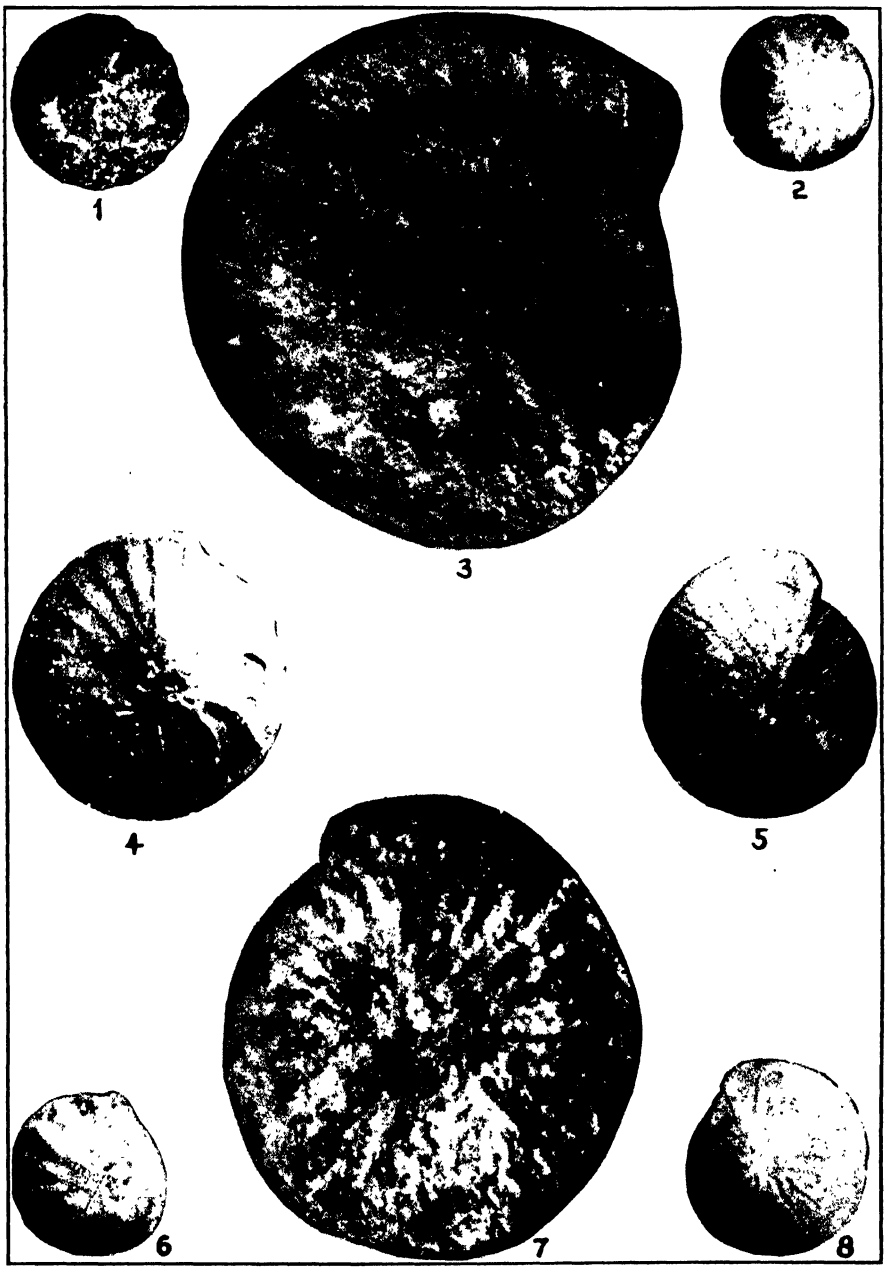
Median sections show regular, rather close coiling, with 4 to 4½ whorls, with 20 to 24 chambers in the final whorl. The sutures are slightly oblique, curving rather strongly as they approach the periphery. In transverse section the rather inflated lenticular form



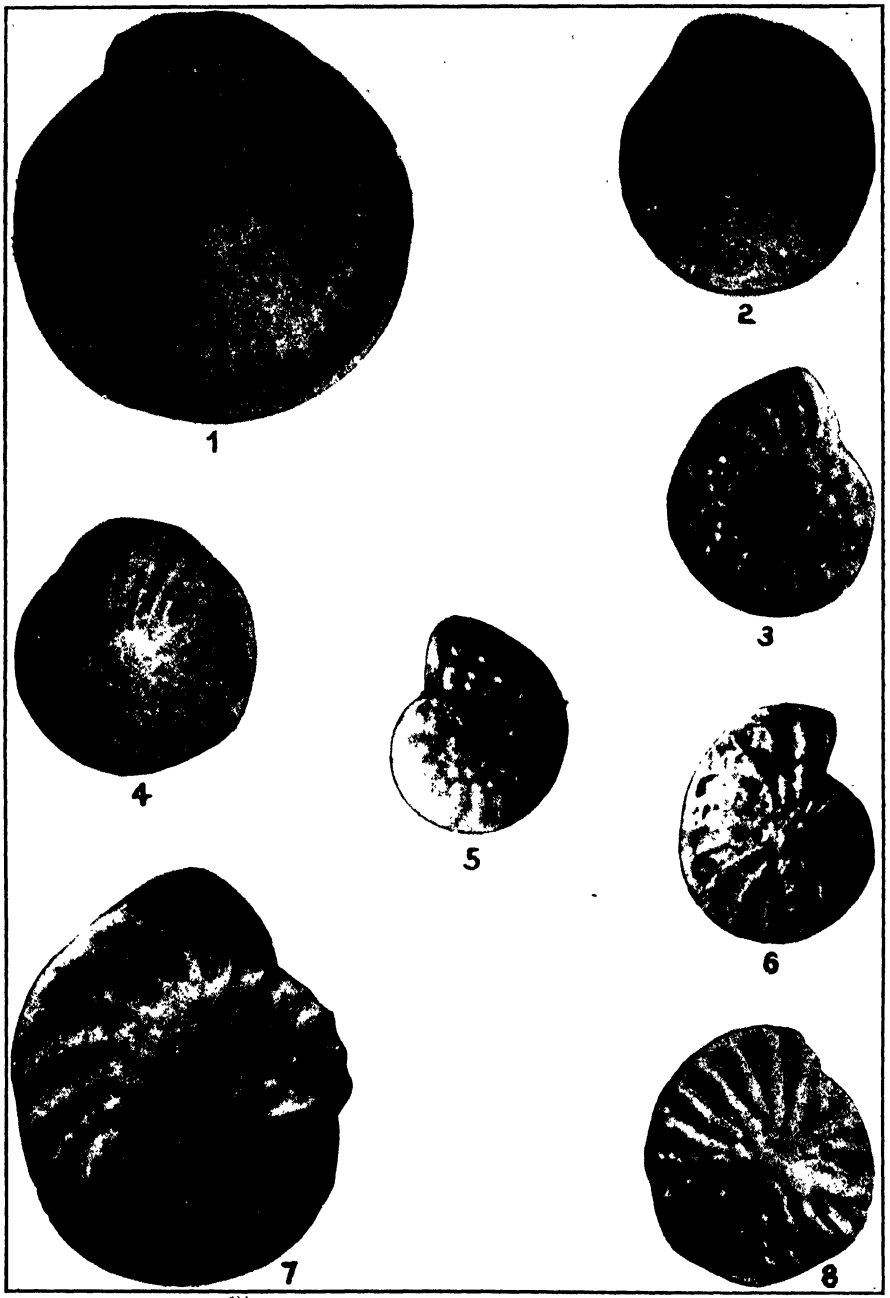
1, *Operculinoides oliveri* (Cushman), probably a topotype, from Guayabal beds, near Romance, Rio Moctezuma, Mexico; 2, 3, *O. vaughani* (Cushman), Guayabal beds, Guayabal, Tamatoco, Veracruz (type locality of W. S. Cole). ×15.



1, *Operculinoides prenummulitiformis*, new species, Guayabal formation, Poza Rica Well no. 8 near Coatzintla, Veracruz; 2, *O. prenummulitiformis*, Guayabal formation, collection E. Gevaerts no. 551, Zanatepec, Veracruz; 3, *Operculinoides* sp. B, Guayabal formation, near Tantoyuca, Veracruz, collection H. Rankin no. 277, Tantoyuca region; 4, *O. ocalanus* (Cushman) *minor*, new variety, Guayabal formation, collection P. von Schumacher no. 2589, east of Tempoal, Veracruz; 5, *O. ocalanus* (Cushman), Tantoyuca, Jackson Eocene, collection K. Goldschmid Pit no. 283, southeast of Tempoal; 6, *O. vicksburgensis* Vaughan and Cole, Alazan formation, collection E. Gevaerts no. 292, southern Miahuapam, Veracruz; 7, *O. jennyi*, new species, Guayabal formation, collection H. Meyer no. 1477, Santa Clara, southeast of Tantoyuca. ×15.



1, 2, *Camerina jacksonensis* Gravell and Hanna *globora*, new variety, lower part of Tantoyuca formation, Jackson Eocene, collection H. Rankin no. 50, east of Tantoyuca, Veracruz; 3, *Operculinoides willcoxii* (Heilprin), Tantoyuca formation, Jackson Eocene, Tantoyuca type locality: Tantoyuca-Chopopo road, east of Tantoyuca; 4, *Camerina guayabalensis*, new species, Guayabal, Claiborne, from Mecatepec Well no. 5; 5, *C. moodybranchensis* Gravell and Hanna, Tantoyuca formation, well sample, Poza Rica no. 7; 6, *C. jacksonensis* Gravell and Hanna, Tantoyuca formation, Tantoyuca-Chopopo road, near Tantoyuca; 7, *C. vanderstoki* (Rutten and Vermunt), Guayabal formation, collection H. Meyer no. 1017, southern Chila Cortaza, east of Tantoyuca; 8, *Operculinoides palmarealensis*, new species, Alazan formation (Huasteca of Muir), lower Oligocene, Mecatepec Well no. 5, near Poza Rica, Veracruz. ×15.



1, 2, *Operculinoides antiguensis* Vaughan and Cole (fig. 1, microspheric form, Meson formation, below Tampico Country Club, Tampico, Tamaulipas; fig. 2, megalospheric form, Meson formation, near Bustos, Veracruz); 3, 5, *O. tuberculatus* (Vaughan and Cole), Tantoyuca formation, collection W. H. Hegwein no. 1559, near Tantoyuca, Veracruz; *O. muiri*, new species, Alazan formation, collection E. Gevaerts no. 269, southern Miahuapam, Veracruz; 6, 8, *O. catenula* (Cushman and Jarvis), lower part of Chicontepec, near Sabaneta, Veracruz, collection W. Tappolet no. 1908; 7, *O. jennyi*, new species, Guayabal formation (Tempoal of ver Wiebe and Muir), near Sabaneta, collection H. Jenny no. 1573. ×15.

of the test, the regular nature of the coiling, and the even development of the walls are well brought out (see pl. 22, fig. 1).

The species seems to be identical with an undescribed species observed in samples from the Byram marl of Byram, Miss. (for which the writer is indebted to Mrs. F. B. Plummer). The nearest described species seems to be *O. vicksburgensis* Vaughan and Cole, but *O. muiri* is considerably thicker than that species (0.7 to 0.9 mm as compared with 0.3 to 0.6 mm) and rather more closely coiled. Dr. T. Wayland Vaughan has examined the types and is of the opinion that the species is new. It has been named after the late John M. Muir, who contributed much toward the elucidation of the stratigraphy of the Tampico region, and whose recent death was felt very deeply by all connected with Mexican stratigraphy and petroleum geology.

Cotypes.—U.S.N.M. nos. 497839 and 497840.

Occurrence.—Lower Alazan (probably restricted to the lower part of Muir's Huasteca formation).

OPERCULINOIDES ANTIGUENSIS Vaughan and Cole

PLATE 14, FIGURES 1, 2; PLATE 16, FIGURE 3; PLATE 17, FIGURE 1; PLATE 21, FIGURES 10, 11

1936. *Operculinoides antiguensis* VAUGHAN and COLE, Proc. U. S. Nat. Mus., vol. 83, p. 492, pl. 38, figs. 7–10.

1937. *Camerina* sp. B THIADENS, Journ. Pal., vol. 11, p. 95, figs. 3B, 3D, pl. 15, fig. 3 (Oligocene, Cuba).

Test small to medium in size, completely involute, lenticular in cross section, with a rather acute periphery. Diameter (megalospheric form), average 2.4 mm, with a maximum observed of 2.8 mm; thickness, average 1.00 mm. The microspheric form (which is fairly plentiful in the Meson outcrops below the Tampico Country Club) is a little larger, averaging 3.5 mm in diameter.

The sutures, seen from the exterior, are radiating, lying flush with the surface of the test, showing as lines of clear shell material proceeding from a clear central mass. In general, sections show 4 whorls, regularly coiled, with a thick outer wall, the final whorl showing 23 to 26 chambers. Exceptional specimens may show 28 or 29 chambers in the last whorl.

The most marked characteristic of the species seen in median sections is the shape of the septa, which are straight and radial for a little more than half their length and then recurved at an abrupt angle toward the periphery (see figure). This character is well shown by Thiadens's *Camerina* sp. B (1937, pl. 15, fig. 3), and there seems little doubt that this should be referred to *O. antiguensis*.

Plesiotypes.—U.S.N.M. nos. 497841 and 497842.

Other specimens.—U.S.N.M. no. 497843.

Occurrence.—This species has been recorded only from the Meson formation, middle to upper Oligocene.

OPERCULINOIDES SEMMESI Vaughan and Cole

PLATE 19, FIGURES 1–6

1936. *Operculinoides semmesi* VAUGHAN and COLE, Proc. U. S. Nat. Mus., vol. 83, p. 491, pl. 37, figs. 10–13 and probably 14; pl. 38, figs. 1–4 and probably 5 and 6.

In early work I included *O. antiguensis* and *O. semmesi* in a single species, with a considerable range in variation, but Vaughan and Cole have separated slightly smaller specimens, with a thinner test and fewer chambers in the final whorl, as *O. semmesi.* This species is similar to *O. antiguensis* in general appearance, but, in large numbers of specimens seen by me, is generally smaller and thinner, though the range in diameter (1.75 to 2.8 mm) is almost the same for the two species. Thickness, 0.55 to 0.65 mm.

Sections show 3 to 3½ whorls, with 18 or 19 chambers in the final whorl. The septa show the same characteristic curvature as *O. antiguensis.* It is still thought that *O. semmesi* may be only a variety or a dwarf race of *O. antiguensis*, since both have the same range in Mexico and have not yet been found to occur in the same localities, suggesting that the differences may be due to local changes in environment.

Plesiotypes.—U.S.N.M. nos. 497844 and 497845.

Other specimens.—U.S.N.M. nos. 497846 and 497847.

Occurrence.—Believed to be restricted to the Meson formation.

OPERCULINOIDES PALMAREALENSIS, new species

PLATE 13, FIGURE 8; PLATE 18, FIGURE 1; PLATE 22, FIGURES 7, 8

Test small, stoutly lenticular, completely involute, with an acute periphery. The septa show as gently curved lines of clear shell material radiating from a large, clear central mass. Diameter, 1.8 to 2.2 mm; thickness, average 0.9 mm.

Sections show the septa to be sharply recurved, somewhat as in *Operculinoides antiguensis* and *O. semmesi*, but the curvature is not so abrupt, the coiling is less regular, and the test is consistently smaller and thicker in proportion to the diameter. Mature specimens usually show 4 whorls, with 18 to 20 chambers in the final whorl. The chambers are somewhat irregular in size and shape.

Cotypes.—U.S.N.M. nos. 497848–497850.

Occurrence.—Alazan formation (Huasteca formation of Muir), lower Oligocene. The description is based on cotypes from Mecatepec Well no. 5, Mecatepec, Veracruz.

OPERCULINOIDES JENNYI, new species

PLATE 12, FIGURE 7; PLATE 14, FIGURE 7; PLATE 17, FIGURE 3; PLATE 19, FIGURE 7; PLATE 21, FIGURE 9

This species was at first separated into two groups according to the degree of granulation of the sutures and the closeness of the coiling, but it is now believed that only one species is represented with a wide range of variation.

Test of medium size, compressed lenticular, completely involute, complanate to a variable extent. The sutures are frequently irregularly beaded, and the poles are sometimes covered with a thick tuberculate mass of shell material, which is part of the final whorl. The sutures are generally raised, and strongly curved near the periphery, which they join at a very oblique angle, as in figures given by Cushman (1921) for *O. ocalanus*. Diameter, up to 6.0 mm, averaging 3.8 mm for 20 specimens; thickness, 0.8 to 1.0 mm.

Sections show rather irregular coiling, a very thick outer wall, and a rapidly opening spiral of 2½ to 3½ whorls, with 18 to 28 chambers in the final whorl. Five sections selected to show the range of variation show the following characters:

Diameter	Number of whorls	Number of chambers in final whorl
Mm		
3.0	2.5	22
3.1	3	18
3.8	3	23
3.7	3.5	21
4.0	3.5	28

The species was at first considered to be a variety of *O. ocalanus* (Cushman), but careful comparison with material from the Ocala limestone and with figures recently published by Vaughan (1937), taken in conjunction with the discovery of *O. ocalanus* at a considerably higher horizon in Mexico, have led me to consider this as a distinct new species. Typical specimens of *O. ocalanus* show fewer chambers in the final whorl and in general a more rapidly opening spiral, though rare specimens of *O. jennyi* occur which show all the essential features of *O. ocalanus*.

An interesting character of this species is shown by transverse sections (see pl. 21, fig. 9). The spiral laminae show incipient subdivision, with splitting off of thin walls, giving lateral cavities suggestive of the lateral chambers of the Orbitoididae. This is a similar character to that shown by *Camerina chawneri* Palmer, which

has recently been made the genotype of a new genus, *Paraspiroclypeus*, by Hanzawa (1937, pp. 116–117). In *O. jennyi*, however, the subdivision is much less plainly marked, the species being considered intermediate between *Operculinoides* and *Paraspiroclypeus*, thus substantiating Hanzawa's theory of the relationship between the two genera.

A further point that may perhaps have some bearing on this is the presence of well-marked multiple apertures (seen in median sections) in *O. jennyi*. These have been figured by Carpenter as "secondary pores" (see also under *O. prenummulitiformis*) and may have led later to subdivision of the chambers into chamberlets as seen in *Spiroclypeus* and *Heterostegina*.

Cotypes.—U.S.N.M. nos. 497855–497858.

Occurrence.—Fairly common in the Guayabal (Tempoal of ver Wiebe and Muir), Claiborne Eocene. Cotypes selected from an outcrop 11 kilometers southeast of Sabaneta, Veracruz; collection of Dr. H. Jenny no. 1573.

This species is named in memory of the late Dr. Hans Jenny, who spent many years carrying out pioneer work in Mexican stratigraphy and collected the types of this and numerous other new species of larger Foraminifera.

OPERCULINOIDES OCALANUS (Cushman)

PLATE 12, FIGURE 5; PLATE 15, FIGURE 5

1921. *Operculina ocalana* CUSHMAN, U. S. Geol. Surv. Prof. Paper 128–E, p. 129, pl. 19, figs. 4, 5.

1935. *Operculina ocalana* CUSHMAN, referred to new genus *Operculinoides* by S. Hanzawa, Sci. Rep. Tôhoku Imp. Univ., ser. 2 (Geol.), vol. 18, no. 1, p. 18.

1937. *Operculina ocalana* Cushman, VAUGHAN *in* Sheppard's "The Geology of South-Western Ecuador," pp. 158–159, figs. 113, 114.

Cushman's original description of *O. ocalanus* reads as follows:

> Test complanate, much compressed, composed of two to three coils, the last with 16 to 18 chambers; sutures raised, confluent in the center, somewhat rounded, the area between concave and smooth; chambers three to four times as long as wide; central area of the test umbonate; periphery somewhat raised by a thickening in which the raised sutures terminate. Length as much as 6 millimeters.
>
> Geologic occurrence, Ocala limestone and Jackson formation.

Specimens from Ecuador are considered by Vaughan to differ in no essential particulars but are generally of smaller size. Specimens from Mexico agree well with the general description of Cushman and the later figures of Vaughan but, like the Ecuadorian specimens, are consistently smaller than the types. The following is a brief description:

Test complanate, much compressed, composed of 2 to 2½ whorls, the final whorl opening into a broad flange occupying the greater part of the test. Owing to bad state of preservation no ornament can be seen, the surface being worn smooth in all specimens found; there is evidence of the presence of an umbo at the center of the test, though not so marked as in typical specimens of *O. ocalanus*. Diameter, up to 3.0 mm (broken); thickness, 0.5 mm. Sections show 12 to 14 chambers in the final whorl, chambers long and narrow and the septa curved throughout, more strongly so as they approach the periphery. As in typical *O. ocalanus* the septa are somewhat raised and there is a strong tendency toward thickening at the periphery.

If we take into account the fact that all the specimens examined were incomplete, the slight differences in size, number of whorls, and number of chambers in the final whorl may be neglected, especially as the proportional development is almost identical with typical specimens of *O. ocalanus* from Ocala limestone.

Plesiotypes.—U.S.N.M. nos. 497859 and 497860.

Occurrence.—In Mexico the species occurs in the Tantoyuca formation, which is considered to belong to the Jackson Eocene. A larger species, very closely allied to *O. ocalanus*, and for a long time confused with that species, occurs in the Claiborne. This has now been referred to a new species, *Operculinoides jennyi.*

OPERCULINOIDES OCALANUS (Cushman) MINOR, new variety

PLATE 12, FIGURE 4; PLATE 15, FIGURES 1, 2; PLATE 21, FIGURE 3

A number of specimens of a small species of *Operculinoides* have been sectioned and are referred to a variety of *O. ocalanus* (Cushman), though perhaps the differences from that species are sufficient to warrant specific distinction. The test is much smaller but shows a similar umbonate form, with raised septa, the septa showing coarser beading or granulation than is customary in *O. ocalanus*.

Sections show the test to consist of 2½ whorls, with 15 or 16 chambers in the final whorl. The chambers are long and narrow, the sutures gently and regularly curved, but showing in general a rather more pronounced "angle" near the periphery than *O. ocalanus*, as may be seen from the figures (pl. 15, figs. 1, 2). Diameter, 2.1 to 2.5 mm; thickness, 0.4 mm.

Cotypes.—U.S.N.M. nos. 497861 and 497862.

Occurrence.—This form occurs rarely in the Guayabal formation (Tempoal of ver Wiebe and Muir, Claiborne) near the town of Tantoyuca, Veracruz. The cotypes were obtained from a locality east of Tempoal, Veracruz; collection of Dr. P. von Schumacher no. 2589.

OPERCULINOIDES VICKSBURGENSIS Vaughan and Cole

PLATE 12, FIGURE 6; PLATE 18, FIGURE 2; PLATE 19, FIGURES 8, 9

1936. *Operculinoides vicksburgensis* VAUGHAN and COLE, Proc. U. S. Nat. Mus., vol. 83, p. 490, pl. 36 (Byram Marl, Vicksburg, Miss.).

Description of Mexican specimens is as follows: Test small to medium size, compressed lenticular, completely involute, periphery rather thick and rounded. The sutures as seen on the exterior are clear lines of shell material, flush with the surface, and slightly sigmoid in shape. The most important feature in the external appearance is the presence of thin lines of clear shell material similar to the subdivision into chamberlets shown by *Heterostegina;* these disappear on sectioning, however, or merely show as thin transparent lines in the shell wall. This character was also seen to be well developed in specimens identified by the writer as *O. vicksburgensis* from the Byram marl of Byram, Miss. (see pl. 19, figs. 8, 9). Diameter, 2.0 to 3.0, average approximately 2.5 mm (compare 1.3 to 3.1 mm for *O. vicksburgensis*).

Sections show the presence of 3 to 3¼ whorls, with 18 to 24 chambers in the last whorl. This compares closely with 3½ to 4 whorls, with 18 to 26 chambers in the final whorl in *O. vicksburgensis.* The septa are straight for two-thirds of their length, then recurve regularly and rather abruptly toward the periphery.

Plesiotypes.—U.S.N.M. no. 497863.

Occurrence.—Alazan formation (Huasteca formation of Muir), lower Oligocene. (Occurs generally in association with *O. muiri.*)

Note.—There is clearly an error in the footnote given by Thiadens (1937, p. 97), referring his *Camerina* sp. C to this species, since the former, in my opinion, is either *Planularia* or *Cristellaria* (see Thiadens's pl. 15, fig. 4).

OPERCULINOIDES OLIVERI (Cushman)

PLATE 11, FIGURE 1; PLATE 15, FIGURE 3

1925. *Operculina oliveri* CUSHMAN, Bull. Amer. Assoc. Petr. Geol., vol. 9, p. 298, pl. 6, figs. 1, 2 (Guayabal, Rio Moctezuma, Mexico).

1927. *Operculina cushmani* COLE, Bull. Amer. Pal., vol. 14, no. 51, p. 23, pl. 2, fig. 14 (Guayabal type locality, Guayabal, Mexico).

Test large, involute, very thin, and complanate. From the exterior the test is seen to consist of a rapidly opening spiral, the septa showing as raised ribs, recurved strongly toward the periphery. There is at times a tendency toward beading on the septa, this being usually more strongly developed toward the center of the test. Diameter, up to 8.0 mm, averaging 4.0 mm.

Sections show the presence of 2 to 3 whorls, with 16 to 28 chambers in the final whorl. This large range is due to the inclusion of

incomplete or immature specimens, adult tests showing generally 24 to 28 chambers in the last whorl. The chambers are long and narrow, the length being about five times the width, the septa thin and regularly curved throughout.

Cole's *O. cushmani* is considered to be the same as Cushman's *O. oliveri* after careful comparison of topotype material of both species (from the Guayabal of the Guayabal type locality and the Moctezuma River, respectively), although it is possible that Cole also included in his species forms referred by the writer to *Operculinoides vaughani* (Cushman), q. v.

O. oliveri is considered to be intermediate between *O. cookei* (Cushman) and *O. vaughani* (Cushman) and may perhaps be ancestral to both. These species have all been referred to *Operculinoides* by Hanzawa, and the involute nature of *O. oliveri* and *O. vaughani* is clearly seen on plate 11, figures 1–3, of the present account.

Plesiotypes.—U.S.N.M. nos. 497864 and 497865.

Occurrence.—So far as is known, restricted to the Guayabal (Tempoal of ver Wiebe and Muir, Claiborne).

OPERCULINOIDES VAUGHANI (Cushman)

PLATE 11, FIGURES 2, 3

1921. *Operculina vaughani* CUSHMAN, U. S. Geol. Surv. Prof. Paper 128–E, p. 128, pl. 19, figs. 6–7.

1933. *Operculina oliveri* ELLISOR, *non* Cole, Bull. Amer. Assoc. Petr. Geol., vol. 17, p. 1299, pl. 2, fig. 15.

1935. *Operculina vaughani* Cushman, GRAVELL and HANNA, Journ. Pal., vol. 9, p. 334, pl. 29, figs. 6, 9, 12, 16–21.

As this species has been well described recently by Gravell and Hanna, and specimens so identified in the Mexican material are rare, it is not considered necessary to give here a detailed description. The species differs from *O. oliveri* (Cushman) in being of smaller size, rather more tightly coiled, and narrower and more numerous chambers and in having more regularly beaded sutures. In Mexico it occurs rather high in the Claiborne and is much less frequent than *O. oliveri.* The best specimens have been found in the Guayabal (Tempoal), Claiborne Eocene, of the Guayabal type locality of Cole; it also has been observed in the Guayabal exposed in the neighborhood of Tantoyuca, Veracruz.

OPERCULINOIDES TUBERCULATUS (Vaughan and Cole)

PLATE 14, FIGURES 3, 5; PLATE 20, FIGURES 9, 11

1936. *Operculina tuberculata* VAUGHAN and COLE, Proc. U. S. Nat. Mus., vol. 83, p. 488, pl. 35, figs. 1–4.

The following description, though to some extent a repetition of that of Vaughan and Cole, is based on a larger collection of material, including specimens from near Tempoal, Veracruz, and from near Tantoyuca, Veracruz.

Test small, flattened, very thin, involute, septa raised, somewhat limbate, and broken up into large tubercles. The poles of the test also show a group of tubercles, or a large central tubercle surrounded by small beads. A well-developed keel gives the test a rather truncated periphery. Diameter, up to 2.0 mm, average 1.8 mm.

Sections show regular, rather open coiling, with 2½ to 3 whorls, with 15 to 20 chambers in the final whorl. The septa are thin and nearly straight for one-half to two-thirds of their length, then gently curved toward the periphery. Chambers not very numerous, with a rather rectangular appearance.

This species was long considered to be a variety of *O. mariannensis* Vaughan (1928), from which it differs principally in the possession of a greater number of chambers, a thicker test and generally more robust form, but it is considered by Vaughan and Cole to rank as a distinct species. In spite of the thinness of the test and the clear marking of all whorls on the exterior, I believe that this species should be referred to *Operculinoides*. This is supported by Hanzawa's placing the closely allied *O. mariannensis* in that genus and by the involute nature of the test shown by the transverse sections figured by Vaughan and Cole (1936, pl. 35, figs. 3, 3a, and 4). My preparations also show this involute character.

Plesiotypes.—U.S.N.M. nos. 497866, 499868, and 497869.

Other specimens.—U.S.N.M. no. 497867.

Occurrence.—Tantoyuca formation, Jackson Eocene.

OPERCULINOIDES CATENULA (Cushman and Jarvis)

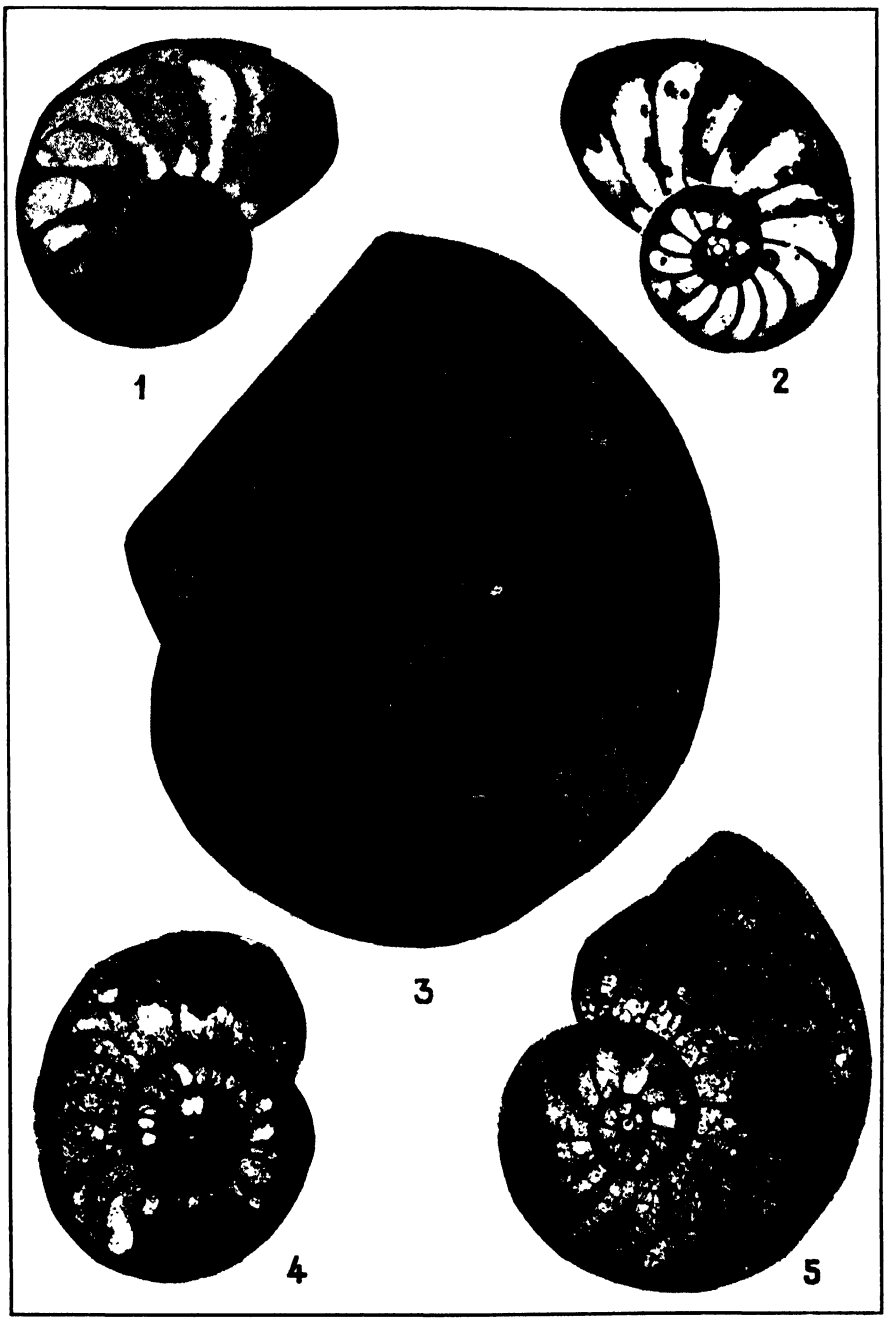
PLATE 14, FIGURES 6, 8; PLATE 18, FIGURE 5; PLATE 21, FIGURES 7, 8

1932. *Operculina catenula* CUSHMAN and JARVIS, Proc. U. S. Nat. Mus., vol. 80, art. 14, p. 42, pl. 12, figs. 13a–b.

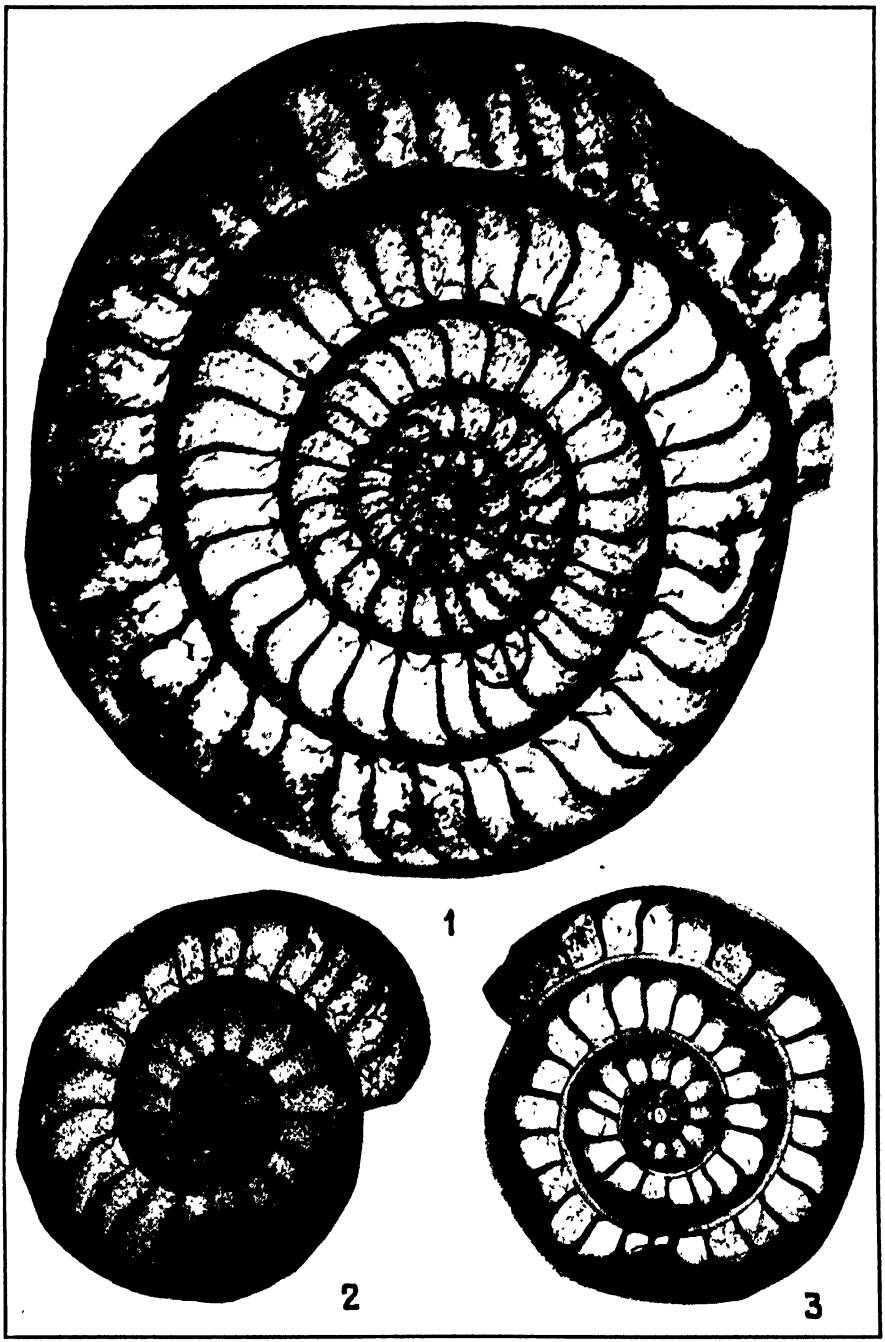
Description of Mexican specimens ascribed to this species is as follows:

Test small to medium in size, compressed lenticular, completely involute, with a strongly developed rounded keel. The sutures (on rather weathered specimens) show as raised radiating ribs, irregularly beaded, with a strong umbonal boss. Diameter, up to 3.0 mm (average 2.5 mm for 5 specimens); thickness, 0.7 to 0.85 mm (cf. diameter 2.25 mm, thickness 0.6 mm for *O. catenula*).

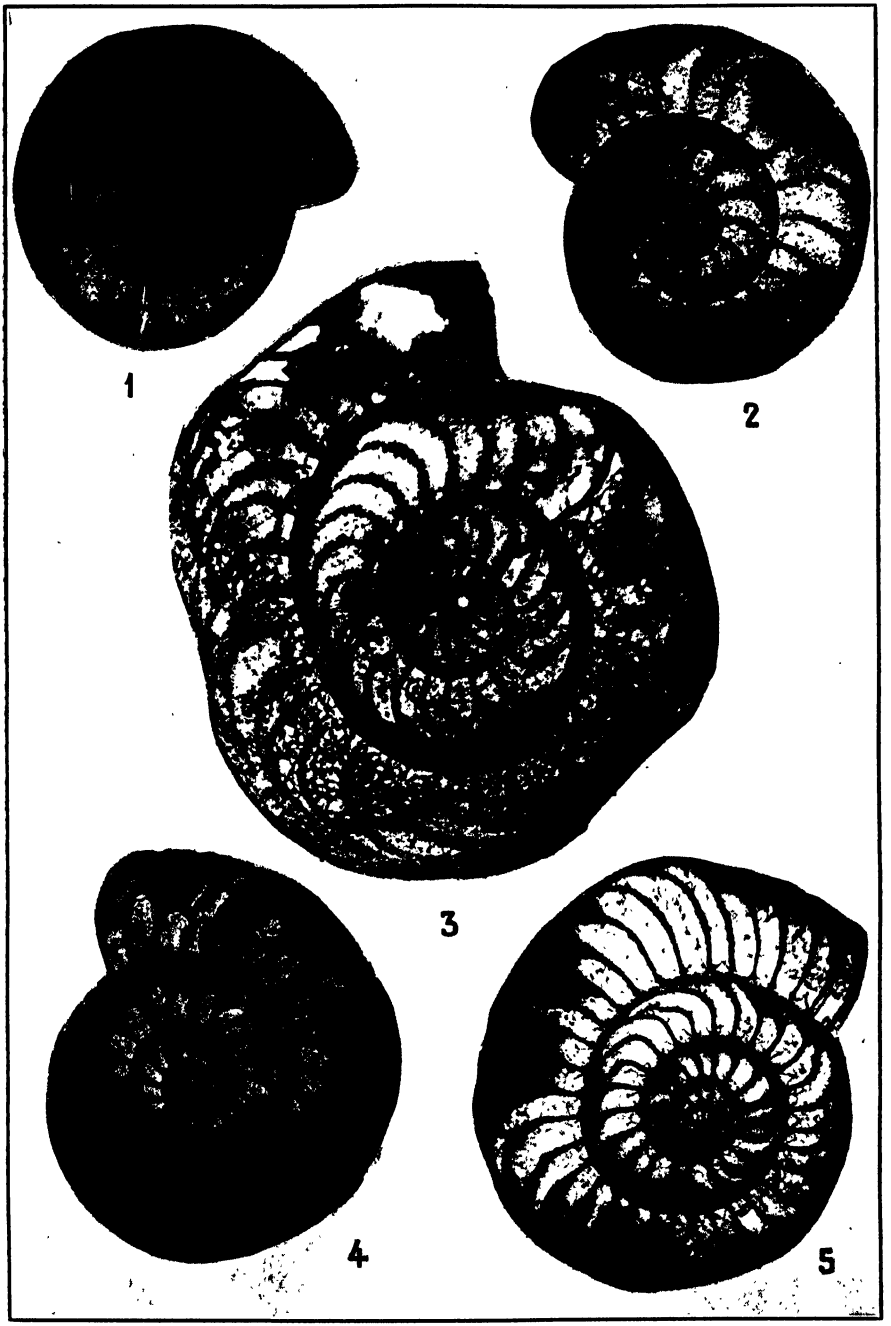
Sections show a rather loosely coiled test of 2 to 2¼ whorls with 17 to 22 chambers in the final whorl (compare 15 chambers in the



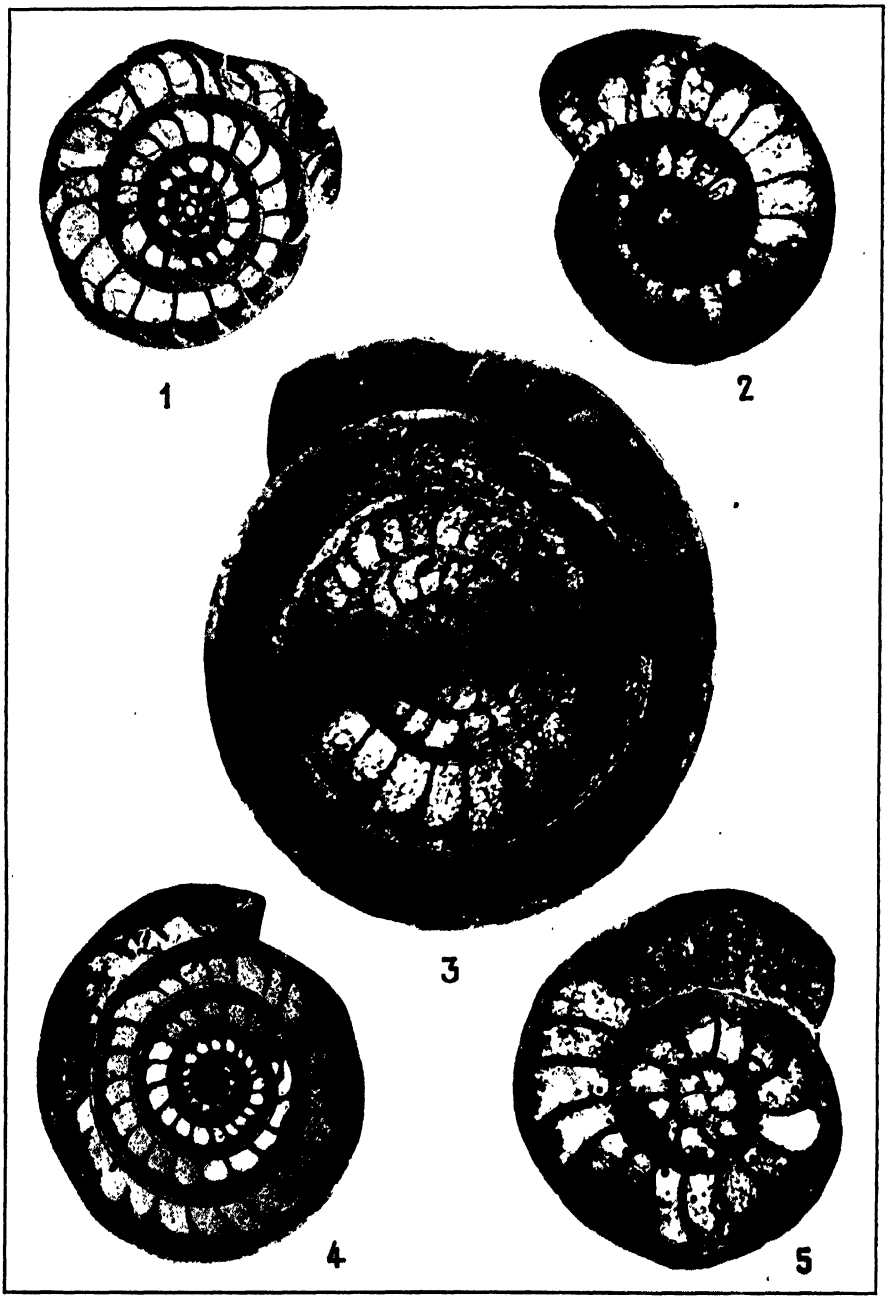
1, 2, *Operculinoides ocalanus* (Cushman) *minor*, new variety, Guayabal formation (Tempoal of ver Wiebe and Muir), collection P. von Schumacher no. 2589, east of Tempoal, Veracruz; 3, *O. olmeri* (Cushman), Guayabal formation, topotype material from Romance, Rio Moctezuma; 4, *Operculinoides* sp. A, Tantoyuca formation, collection P. von Schumacher no. 1624, east of Tempoal; 5, *O. ocalanus* (Cushman), Tantoyuca formation, collection K. T. Goldschmid Pit. no. 283, southeast of Tempoal. ×20.



1, *Operculinoides willcoxii* (Heilprin), Tantoyuca formation, near Tantoyuca, Veracruz (Tantoyuca type locality); 2, *O. tuxpanensis* (Thalmann), Tuxpam formation, lower Miocene, near Tuxpam, Veracruz; 3, *O. antiguensis* Vaughan and Cole, Meson formation, near Bustos, Veracruz (Bustos Well no. 1). ×20.



, *Operculinoides antiguensis* Vaughan and Cole, Meson formation, Bustos Well no. 1, near Bustos, Veracruz; 2, *O. tuxpanensis* (Thalmann), Tuxpam formation, near Tuxpam, Veracruz; 3, *O. jennyi*, new species, Guayabal formation, near Sabaneta, Veracruz, collection H. Jenny no. 1573; 4, *O. prenummulitiformis*, new species, Guayabal formation, well sample, Poza Rica no. 8; 5, *O. nummulitiformis* (Rutten), Tantoyuca formation, collection P. von Schumacher no. 2412, east of Tempoal, Veracruz. ×20.



1, *Operculinoides palmarealensis*, new species, Alazan formation (Huasteca of Muir), Mecatepec Well no. 5; 2, *O. vicksburgensis* Vaughan and Cole, Alazan formation, collection E. Gevaerts no. 292, southern Miahuapam, Veracruz; 3, *Camerina vanderstoki* (Rutten and Vermunt), Guayabal formation, near Furbero, Veracruz, collection J. Clopton no. 21; 4, *C. guayabalensis*, new species, Guayabal (Tempoal of ver Wiebe and Muir), well sample, Poza Rica no. 8; 5, *Operculinoides catenula* (Cushman and Jarvis), lower part of Chicontepec formation, near Sabaneta, Veracruz, collection W. Tappolet no. 1848. ×20.

last whorl in *O. catenula*). The sutures are rather thick and gently curved, the keel showing as a thick outer shell wall along the periphery.

O. catenula was described by Cushman and Jarvis from beds in Trinidad regarded as Upper Cretaceous, showing many species in common with the Velasco of Mexico. There seems little doubt that the Mexican species should be referred to *O. catenula*, or, if not to that species, to a variety, but the original description and figures are inadequate for exact determination of the original species and comparative material was unfortunately not available for study. It has been placed in *Operculinoides* on account of the involute nature and the rather loose coiling. In some respects it is not unlike *Pellatispirella* but lacks the special features of the aperture and construction of the shell wall of that species.

Plesiotypes.—U.S.N.M. nos. 497870 and 497871.

Occurrence.—In Mexico the species occurs in beds of doubtful age, which may perhaps be referable to the Chicontepec (probably Tanlajas formation of Muir).

OPERCULINOIDES species A

PLATE 15, FIGURE 4; PLATE 21, FIGURE 6

Test small, compressed, completely involute. Ornamentation, if present, is completely obscured by the bad state of preservation. Diameter, 2.2 mm (average); thickness, 0.5 mm. Sections show 2¼ to 2½ whorls, with 21 to 23 chambers in the final whorl. The septa are rather thick and regularly curved throughout their length.

In many respects this species is similar to *Operculinoides advenus* Vaughan and Cole, which has not been observed in the collections examined. It differs from the latter, however, in having fewer coils and being in general a smaller form. On account of the small amount of material available, it has been thought inadvisable to give a specific denomination at the present time.

Cotypes.—U.S.N.M. nos. 497872 and 497873.

Occurrence.—Rare in the Tantoyuca formation, Jackson Eocene. The above description is based on specimens obtained east of Tempoal, Veracruz; collection of Dr. P. von Schumacher no. 1624.

OPERCULINOIDES species B

PLATE 12, FIGURE 3; PLATE 20, FIGURE 7; PLATE 21, FIGURE 5

Test small, compressed lenticular, completely involute, surface smooth, without ornamentation, septa showing as lines of clear shell material. A number of small, regularly spaced tubercles occur between the septa, in a line parallel to and near the periphery (see

pl. 12, fig. 3); these may appear only on weathering and are of value in distinguishing this species from other closely similar small species. Diameter, average 2.0 mm; thickness, 0.5 mm.

Sections show the test to be close-coiled, consisting of 4 to 5 whorls, with 22 to 24 chambers in the final whorl. The septa are of moderate thickness, oblique and gently curved, the chambers being only slightly longer than wide. Owing to the rarity of the species in the collections examined the material is considered insufficient for the erection of a new species.

Cotypes.—U.S.N.M. nos. 497874, 497875, 497876, and 497877.

Occurrence.—Guayabal (ver Wiebe's Tempoal), Claiborne Eocene; rare. The description is based on specimens from the Tantoyuca region, Veracruz; collection of H. E. Rankin no. 277.

? OPERCULINOIDES species

PLATE 20, FIGURE 6; PLATE 21, FIGURE 4

Test small, compressed lenticular, sharply keeled, and completely involute. The sutures are nearly straight, radiating, and show a slight tendency to become beaded toward the center. The appearance is similar to flattened specimens of *Camerina jacksonensis* Gravell and Hanna. Diameter (for 10 specimens), 1.3 mm; thickness, 0.3 to 0.4 mm.

Sections show a test of 3 to 3½ whorls, with 11 to 13 chambers in the final whorl. The septa are oblique and only slightly curved, the chambers being slightly greater in width than in length. From the scarcity and bad state of preservation of the material it is difficult to say whether the species should be referred to *Camerina* or *Operculinoides*, and for these reasons it is considered unwise to give a name to the species until more and better preserved material is available for further study.

Cotypes.—U.S.N.M. nos. 497878 and 497879.

Occurrence.—Very rare in the Tantoyuca formation, Jackson Eocene. The description is based on specimens from near Los Ajos, Hacienda Santa Clara, southeast of Tantoyuca, Veracruz; collection of Dr. H. Meyer no. 1471.

Genus CAMERINA Bruguière, 1792

CAMERINA VANDERSTOKI (Rutten and Vermunt)

PLATE 13, FIGURE 7; PLATE 18, FIGURE 3; PLATE 22, FIGURES 10–12

1932. *Nummulites vanderstoki* RUTTEN and VERMUNT, Proc. Sect. Sci. Kon. Akad. Wetensch. Amsterdam, vol. 35, p. 240, pl. 1, fig. 8; pl. 2, figs. 6, 12.

One of the commoner forms of *Camerina* found in Mexico has been referred to *C. vanderstoki*, after careful comparison with the fig-

ures and description of that species, and although it occurs at a lower horizon in Mexico (Claiborne) than in Curaçao (Jackson) it is considered to be at most only a minor variant of Rutten and Vermunt's species. As the stratigraphy of the various West Indian islands is in a somewhat chaotic state, there may perhaps be an error in the horizon ascribed to *N. vanderstoki* in Curaçao.

Description of the Mexican specimens is as follows: Test small to medium in size, flattened lenticular, completely involute, sutures rather obscure owing to state of preservation, radiate, may be slightly raised (due to weathering?), with a tendency to form beads of clear shell material in the umbonal region. Diameter, up to 4.5 mm, average 3.5 mm; average thickness, 1.2 mm (1.1 to 1.3 mm for 7 specimens).

Sections show 4½ to 5½ whorls, with 27 to 30 chambers in the final whorl. The septa are regular, nearly straight for a little more than half their length, then evenly recurved toward the periphery. The chambers are rather longer in proportion to their width than in the smaller, somewhat similar species, *Camerina guayabalensis*. Below are given figures for comparison of material from Mexico with the type from Curaçao:

Species	Diameter	Thickness	Number of whorls	Chambers in final whorl
	Mm	*Mm*		
Camerina vanderstoki Mexican specimens	3.5	1.2	4.5–5	27–30
Nummulites vanderstoki Rutten and Vermunt (from Curaçao)	3.0	1.2–1.25	4.5–5	18–24

Plesiotypes.—U.S.N.M. nos. 497880, 497881, and 497882.
Other specimens.—U.S.N.M. nos. 497883 and 497884.

CAMERINA MOODYBRANCHENSIS Gravell and Hanna

PLATE 13, FIGURE 5; PLATE 20, FIGURE 2; PLATE 22, FIGURE 2

1935. *Camerina moodybranchensis* GRAVELL and HANNA, Journ. Pal., vol. 9, p. 332; pl. 29, figs. 15, 22–24.

This species has been well described and figured already by Gravell and Hanna, so only a few notes will be given on Mexican specimens ascribed to this species.

Test small to medium in size, compressed lenticular, completely involute. The septa are not raised and show as nearly straight radiating lines of clear shell material. Diameter, average 2.5 mm; thickness, 0.7 to 0.8 mm.

Sections show a rather tightly coiled test of 4 to 5 whorls with 25 to 30 chambers in the final whorl. The septa are gently curved and only very slightly oblique. A comparison of the dimensions and

the accompanying figures with those given by Gravell and Hanna shows only slight divergences, and this is supported by comparison of Mexican specimens with material identified as *C. moodybranchensis* from a well core in Montgomery County, Tex.

Plesiotypes.—U.S.N.M. nos. 497885, 497887, and 497888.

Other specimens.—U.S.N.M. no. 497886.

Occurrence.—Tantoyuca formation, Jackson Eocene, in Tantoyuca area.

CAMERINA JACKSONENSIS Gravell and Hanna

PLATE 13, FIGURE 6; PLATE 20, FIGURE 8; PLATE 22, FIGURE 9

1935. *Camerina jacksonensis* GRAVELL and HANNA, Journ. Pal., vol. 9, p. 331; pl. 29, figs. 1–5, 7–8, 10–11, 13–14.

Mexican specimens identified as *C. jacksonensis* may be described as follows:

Test small, lenticular, completely involute. The septa are of clear shell material, radiating, straight to slightly curved, and generally obscurely beaded toward the umbonal region, where there is a mass of clear shell material of varying extent. Diameter (average for 10 specimens), 1.6 mm; thickness, average 0.6 mm.

Sections show a regularly coiled test of 4 to 4½ whorls with 15 to 19 chambers in the final whorl. The septa are oblique and show a gentle, even curvature. The spacing of the septa appears to be somewhat variable, some specimens showing open spacing with chambers nearly as wide as long (see pl. 20, fig. 8) and others a much closer spacing with chambers correspondingly more elongate. Typical specimens, as figured by Gravell and Hanna, show stronger beading than is usually shown by the Mexican material, but this is considered to be insignificant.

Plesiotypes.—U.S.N.M. nos. 497889 and 497890.

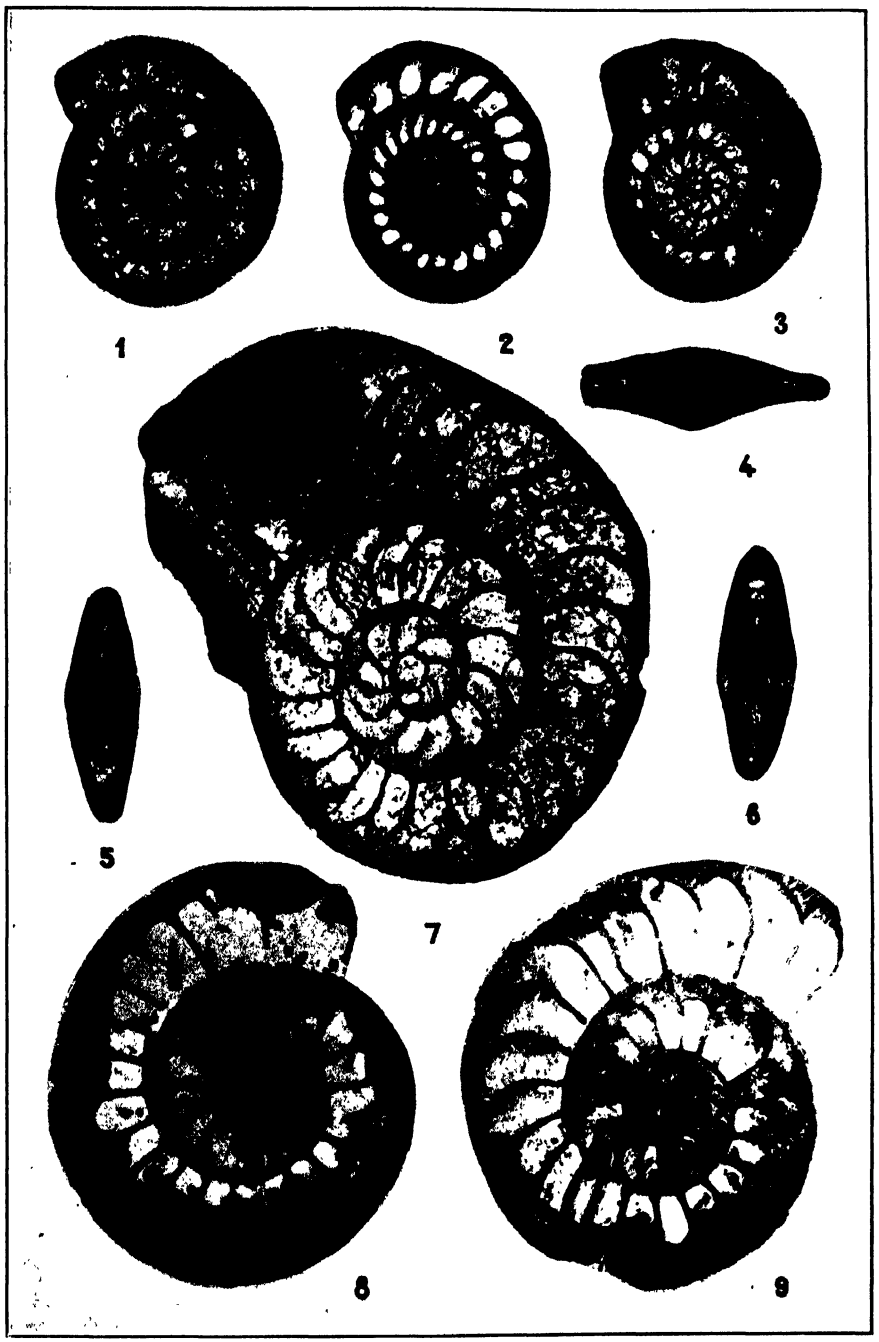
Occurrence.—Occurs fairly abundantly in the lower part of the Tantoyuca formation, Jackson Eocene.

CAMERINA JACKSONENSIS GLOBOSA new variety

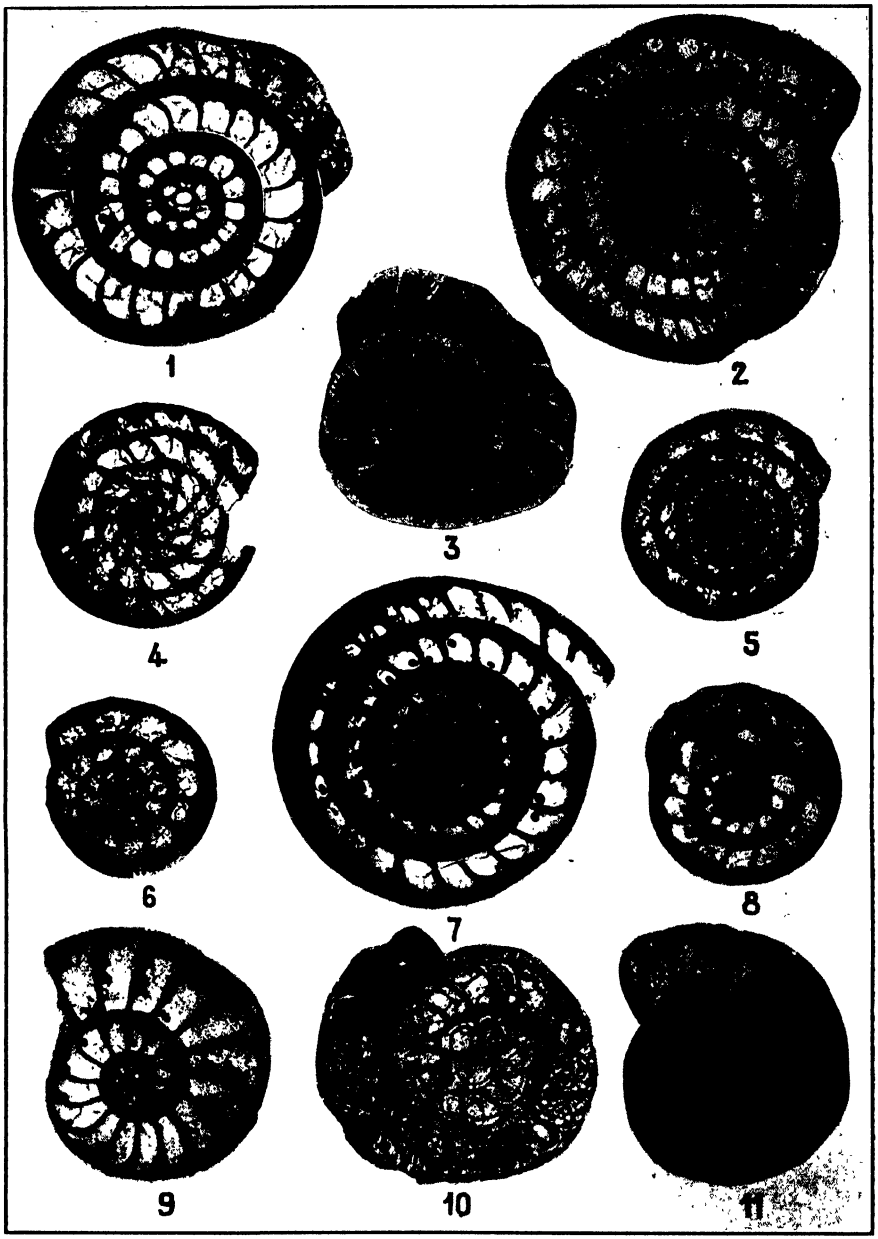
PLATE 13, FIGURES 1, 2; PLATE 20, FIGURES 4, 5; PLATE 22, FIGURES 5, 6

Test small, stoutly lenticular to subglobose, completely involute, with sharply keeled periphery. The sutures are seen to be radiate and may be raised into ribs, which tend to be beaded to a variable extent, especially toward the center, where they frequently coalesce into a boss of clear shell material. Diameter, up to 2.0 mm (average 1.7 mm); thickness, average 0.9 mm.

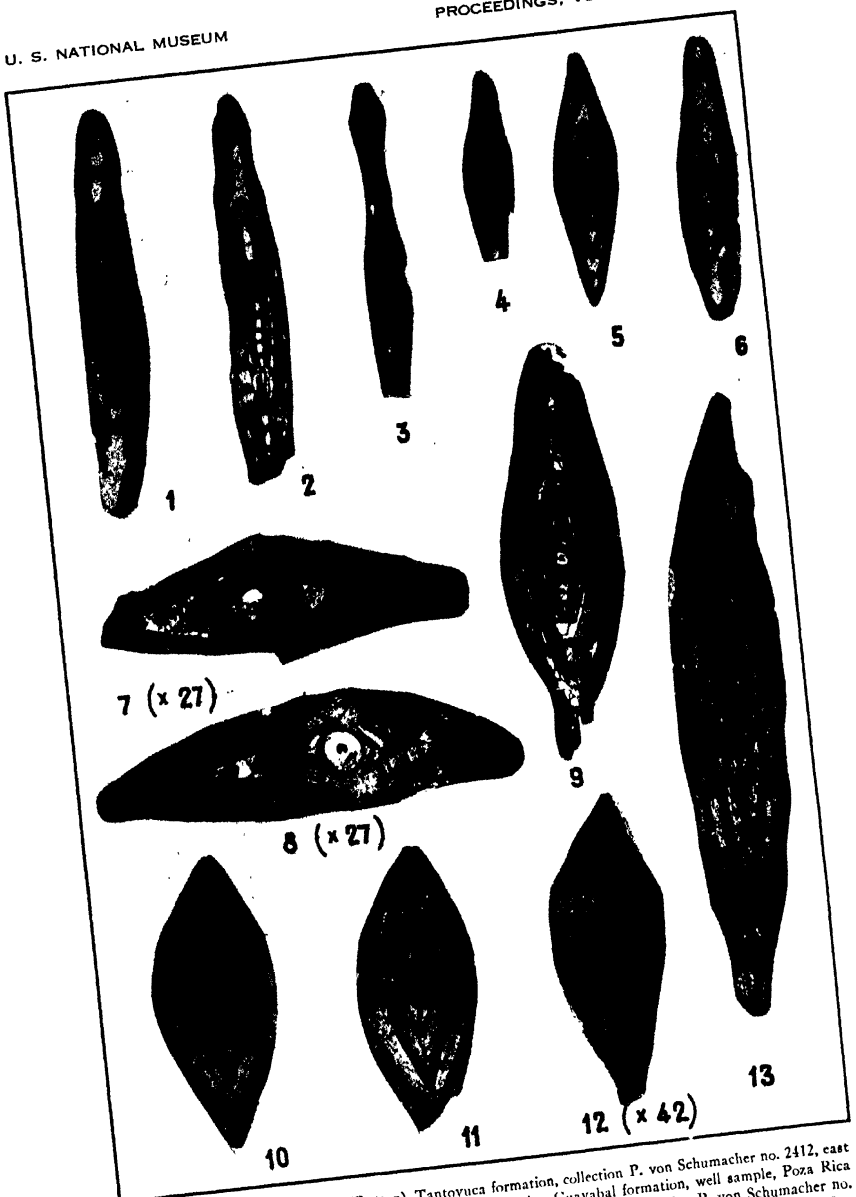
Sections show the test to be rather tightly coiled, consisting of 4½ to 5 whorls, with 15 to 17 chambers in the final whorl. The septa are oblique and gently curved throughout their length.



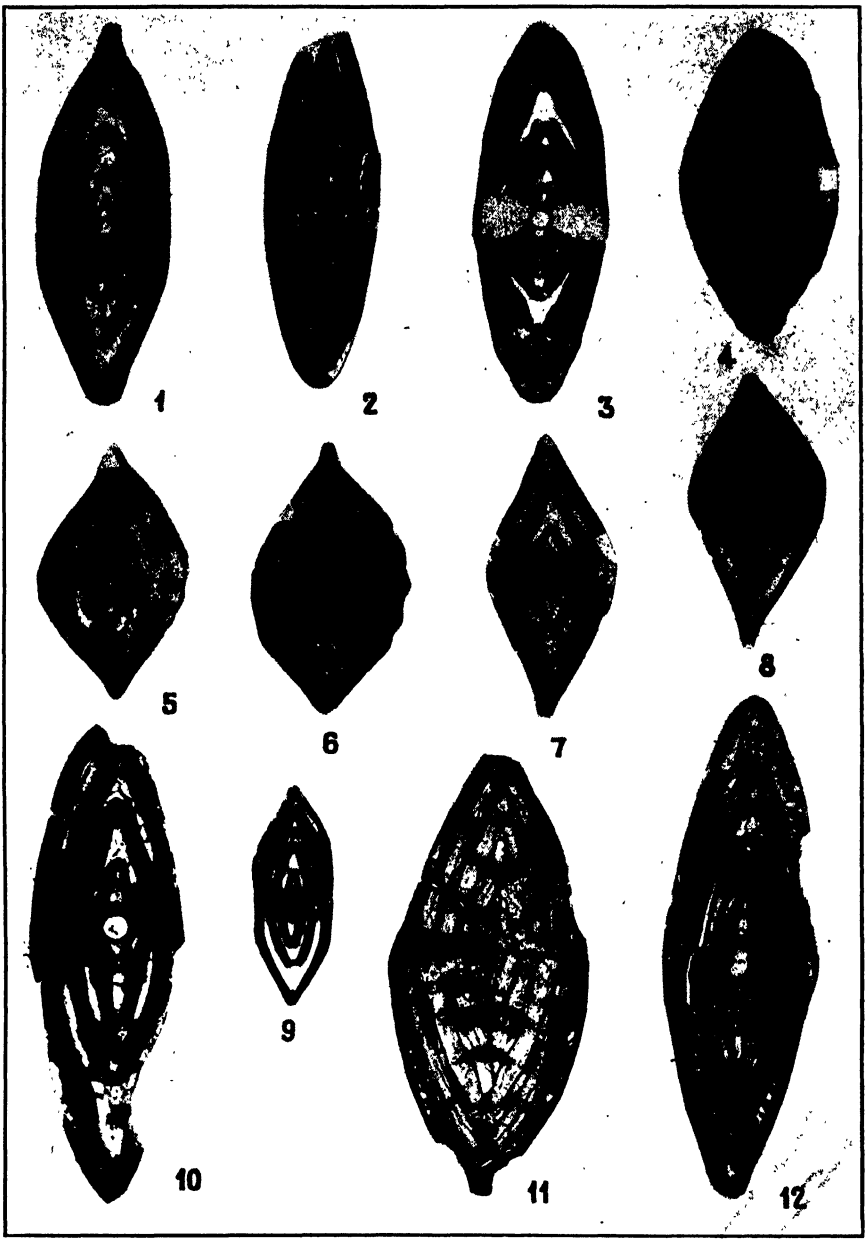
1–6, *Operculinoides semmesi* Vaughan and Cole, Meson formation near Potrero del Llano, Veracruz; 7, *O. jennyi* new species, Guayabal formation (Tempoal of ver Wiebe and Muir), near Sabaneta, Veracruz, collection H. Jenny no. 1573; 8, 9, *O. vicksburgensis* Vaughan and Cole, specimens from Byram, Miss., for comparison with Mexican specimens. ×20.



1, *Operculinoides muiri*, new species, Alazan formation (Huasteca of Muir), collection F. Gevaerts no. 269, southern Miahuapam, Veracruz; 2, *Camerina moodybranchensis* Gravell and Hanna, Tantoyuca, well sample, Poza Rica no. 7; 3, ?*C. dickersoni* Palmer, Cardenas beds (Upper Cretaceous), near Cardenas, San Luis Potosi, ×42; 4, 5, *C. jacksonensis* Gravell and Hanna *globosa*, new variety, Tantoyuca formation, near Tantoyuca, Veracruz, collection W. H. Hegwein no. 2483; 6, ?*Operculinoides* sp., Tantoyuca formation, collection H. Meyer no. 1471, near Los Ajos, Santa Clara, southeast of Tantoyuca; 7, *Operculinoides* sp. B, Guayabal formation (Tempoal of Muir and ver Wiebe), collection H. Rankin no. 277, Tantoyuca region; 8, *Camerina jacksonensis* Gravell and Hanna, Tantoyuca formation, Tantoyuca type locality, near Tantoyuca; 9, 11, *Operculinoides tuberculatus* (Vaughan and Cole), Tantoyuca formation, collection W. H. Hegwein no. 1559, Tantoyuca region; 10, *Camerina pellatispiroides*, new species, El Cristo Well no. 1. All figures except fig. 3 ×20.



1, *Operculinoides nummulitiformis* (Rutten), Tantoyuca formation, collection P. von Schumacher no. 2412, east of Tempoal, Veracruz; 2, *O. prenummulitiformis*, new species, Guayabal formation, well sample, Poza Rica no. 8; 3, *O. ocalanus* (Cushman) *minor*, new variety, Guayabal formation, collection P. von Schumacher no. 2589, east of Tempoal; 4, *?Operculinoides* sp., Tantoyuca formation, collection H. Meyer no. 1471, near Los Ajos, Santa Clara, southeast of Tantoyuca; 5, *Operculinoides* sp. B, Guayabal formation, collection H. E. Rankin no. 277, near Tantoyuca; 6, *Operculinoides* sp. A, Tantoyuca formation, collection P. von Schumacher no. 1624, east of Tempoal; 7, 8, *O. catenula* (Cushman and Jarvis), lower part of Chicontepec formation, near Sabaneta, collection W. Tappolet no. 1848, ×27; 9, *O. jennyi*, new species, Guayabal formation (Temporal of ver Wiebe and Muir), near Sabaneta, collection H. Jenny no. 1573; 10, 11, *O. antiguensis* Vaughan and Cole, Meson formation, bluff below Tampico Country Club, Tampico, Tamaulipas; 12, *?C. dickersoni* Palmer, Cardenas beds (Upper Cretaceous), Cardenas, San Luis Potosi, ×42; 13, *O. willcoxii* (Heilprin), Tantoyuca type locality, near Tantoyuca on road to Chopopo, Veracruz. All figures except figs, 7, 8, and 12 ×20.



1, *Operculinoides muiri*, new species, Alazan formation (Huasteca of Muir), collection E. Gevaerts no. 269, southern Miahuapam, Veracruz; 2, *Camerina moodybranchensis* Gravell and Hanna, Tantoyuca formation, well sample, Poza Rica no. 7; 3, *C. guayabalensis*, new species, Guayabal formation (Tempoal of ver Wiebe and Muir), well sample, Poza Rica no. 8; 4, *C. pellatispiroides*, new species, lower part of Chicontepac formation, El Cristo Well no. 1, Veracruz; 5, 6, *C. jacksonensis* Gravell and Hanna *globosa*, new variety, Tantoyuca formation, collection W. H. Hegwein no. 1503, near Tantoyuca; 7, 8, *Operculinoides palmarealensis*, new species, Alazan formation (Huasteca of Muir), Mecatepec Well no. 5, Veracruz; 9, *C. jacksonensis* Gravell and Hanna, Tantoyuca formation, Tantoyuca type locality, Tantoyuca-Chopopo road, Veracruz; 10–12, *Camerina vanderstoki* (Rutten and Vermunt), Guayabal formation, near Tempoal, Veracruz, collection A. T. Nolthenius no. 157. ×20.

The principal difference from typical *C. jacksonensis* lies in the more globose form of the test, as is indicated by the varietal name. This is clearly shown by the transverse sections figured.

Cotypes.—U.S.N.M. nos. 497891, 497894–497896.

Other specimens.—U.S.N.M. nos. 497892 and 497893.

Occurrence.—The variety occurs in the Tantoyuca formation, Jackson Eocene, possessing a similar range and distribution to the typical form.

CAMERINA GUAYABALENSIS, new species

PLATE 13, FIGURE 4; PLATE 18, FIGURE 4; PLATE 22, FIGURE 3

Test small to medium in size, compressed globose-lenticular, and completely involute. The strongly developed rounded keel of clear shell material gives a somewhat truncated appearance to the periphery. Septa nearly straight, anastomosing to a variable extent at the poles of the test, where there may be developed a small mass of clear shell material. Diameter averages 2.8 mm, with a maximum observed of 3.5 mm; average thickness, 0.85 to 0.95 mm.

Median sections show regular coiling with a thick outer wall (forming the keel mentioned above). The chambers are typically camerinid in character, being nearly as wide as long, with nearly straight septa, slightly oblique and joining the periphery in a gentle curve. There are 4½ to 5 whorls, with 24 to 27 chambers in the final whorl. The canal system is typically that of *Camerina.*

This species is in many respects similar to *C. vanderstoki* (Rutten and Vermunt), both in exterior and in section, but the latter is generally larger and thicker, does not show such a heavily developed keel (with truncation of the periphery), and in section shows more chambers in the final whorl (28 to 30 chambers in *C. vanderstoki* compared with 24 to 27 in *C. guayabalensis*).

Cotypes.—U.S.N.M. nos. 497897 and 497898.

Occurrence.—In the Guayabal (Tempoal of ver Wiebe and Muir) this species is of fairly frequent occurrence, in association as a rule with *Eulinderina guayabalensis* (Nuttall) and *Operculinoides prenummulitiformis.* Cotypes have been selected from Mecatepec Well no. 5 and Poza Rica Well no. 8, Veracruz, the latter material giving superior results on sectioning.

CAMERINA PELLATISPIROIDES, new species

PLATE 20, FIGURE 10; PLATE 22, FIGURE 4

While investigating samples from El Cristo Well no. 1 with a view to obtaining topotype material of *Discocyclina cristensis* (Vaughan) and *Actinosiphon semmesi* Vaughan, I found several specimens of a small globose camerinid. On sectioning, the species

was seen to differ very considerably from any other Mexican form examined, being similar in some respects to *Camerina wadiai* (L. M. Davies, 1927, p. 273, pl. 21, figs. 17, 18; pl. 22, figs. 7–9), from the Eocene of India. With the recent appearance of Hanzawa's (1937) paper on *Pellatispirella* it was seen to show close affinities with that genus, and for a time was thought to be allied to *P. antillea* Hanzawa. Detailed sectioning shows, however, that though measurements agree well with that species, the apertural characters are those of *Operculina* and *Camerina*, and no evidence was found of the complex double shell wall characteristic of *Pellatispirella*. The canal system seems to be much simpler than is usual in *Camerina*, showing many similarities to *Pellatispirella*, and the species may be ancestral to that genus, thus giving some slight evidence for the inclusion of *Pellatispirella* in the Camerinidae.

A description of the new species is as follows: Test small, globosely lenticular, completely involute. The ornament is not discernible owing to the very poor state of preservation, with secondary crystallization on the exterior. Diameter, 1.5 to 2.0 mm; thickness, 1.0 mm.

Sections show the test to consist of 2 to 2½ whorls, with 7 or 8 chambers in the first whorl, 15 or 16 in the second whorl, and in the case of larger specimens (2½ whorls), 16 or 17 chambers in the final whorl. The initial chamber, which is spherical to subspherical in shape, measures 220μ to 270μ in diameter. The walls and septa are very thick, the latter being rather irregular and only slightly curved. The canal system consists of a well-developed marginal cord, as in *Rotalia*, with few branches (in distinction from the many branching marginal system in *Camerina*); strongly developed septal canals; vertical canals, especially in the umbonal region, are seen in transverse sections.

Cotypes.—U.S.N.M. no. 497899.

Occurrence.—Basal Eocene, in association with *Discocyclina cristensis* (Vaughan) and *Actinosiphon semmesi* Vaughan (probably Chicontepec, or the Tanlajas of Muir). Cotypes have been selected from samples from El Cristo Well no. 1, 3,785–3,790 feet.

?CAMERINA DICKERSONI Palmer

PLATE 20, FIGURE 3; PLATE 21, FIGURE 12

1934. *?Camerina dickersoni* PALMER, Mem. Soc. Cubana Hist. Nat., vol. 8, p. 243, figs. 4, 5, pl. 14, figs. 1, 2, 4, 6, 8.

Test very small, compressed lenticular, completely involute, with a well-developed keel of clear shell material. The septa are radiate, gently curved, terminating at the umbo in a rather large central boss. Diameter (average for 10 specimens), 1.0 mm; thickness, 0.3 to 0.45 mm.

Sections show 2½ to 2¾ whorls, with 17 to 20 chambers in the final whorl, but as the specimens are badly preserved it is possible that well-preserved adult specimens would show a slightly larger test with more chambers in the final whorl. The septa are seen to be thick, with well-marked canals giving the appearance of double shell walls. The general appearance in both median and transverse sections differs considerably from that of *Camerina*, there being closer resemblance to *Pellatispirella* as suggested by Hanzawa (1937, p. 115), though the sections fail to reveal the typical apertural characters and structure of the shell wall and canal-system of that genus. It is possible that this species, with *C. cubensis* Palmer and *C. vermunti* Thiadens, all occurring in the Upper Cretaceous, should be referred to a new genus, one of the principal features being the presence of a deep peripheral groove not seen in other species of Camerinidae.

The principal difference between *C. dickersoni* and *C. vermunti* (from study of Mexican specimens of the former) seems to be in the form of the septa, which are much thicker and more curved in the former species. Other characters are compared in the following table:

Species	Diameter	Thickness	Number of whorls	Number of chambers in final whorl
	Mm	*Mm*		
C. dickersoni Palmer	[1] 1.0	[1] 0.33	2.5	16
C. dickersoni Palmer (Mexican specimens)	[2] 1.0	0.3–0.45	2.5–2.75	17–20
C. vermunti Thiadens	1.0–1.5	0.4–0.7	3–3.5	19–23

[1] Cotype.
[2] Average.

It is seen that the Mexican specimens approximate very closely *C. dickersoni*, although the differences between the three species are not great.

Plesiotypes.—U.S.N.M. nos. 497901 and 497902.

Other specimens.—U.S.N.M. no. 497900.

Occurrence.—This species occurs in Mexico in the Upper Cretaceous Cárdenas beds exposed in the railroad cuttings near Cárdenas, San Luís Potosí, where it is associated with *Lepidorbitoides minima* Douvillé and *?Meandropsina rutteni* Palmer. This is a similar assemblage to that reported from Cuba, and to date the species has not been recorded from other localities in the Tampico Embayment.

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NOTE

Additional American species of *Operculina* and *Nummulites* (*Camerina*) have been described by F. M. Anderson (*N. carmenensis*, Proc. California Acad. Sci., ser. 4, vol. 17, no. 1, p. 26, pl. 1, figs. 23, 24, 1928); Katherine van Winkle Palmer (*N. costaricensis*, Bull. Amer. Pal., vol. 10, no. 40, p. 9, pl. 1, fig. 9, 1923); P. J. Pijpers (*O. bonairensis*, "Geology and Palaeontology of Bonaire (Dutch West Indies)," p. 56, pl. 1, figs. 32, 33, 1933); and Willard Berry (*O. atascaderensis*, *O. a. samanica*, *O. peruviana*, *O. samanica*, and *O. talara*, Eclogae geol. Helvetiae, vol. 23, 1930, and Journ. Washington Acad. Sci., vol. 22, 1932). These are not considered of sufficient importance in connection with the present studies to warrant their inclusion in the foregoing list of literature.

While the present account was awaiting publication two important additions were made to the literature of the American species of Camerinidae; namely, "The *Lepidocyclina texana* Horizon in the *Heterostegina* Zone, Upper Oligocene of Texas and Louisiana," by Donald W. Gravell and Marcus A. Hanna (Journ. Pal., vol. 11, pp. 517–529, pls. 60–65, 1937), in which two new species were described (*Operculinoides ellisorae* and *O. howei*), and "Stratigraphy and Micropaleontology of Two Deep Wells in Florida," by W. Storrs Cole (Florida Dept. Conserv. Geol. Bull. 16, pp. 1–73, pls. 1–12, 1938), referring to several American species of *Operculinoides*, with excellent figures. It is regretted that these publications were received too late for inclusion in the discussion of the Mexican species of *Operculinoides*. Reference should also be made to a recent paper by Donald W. Gravell and Marcus A. Hanna, entitled "Subsurface Tertiary Zones of Correlation through Mississippi, Alabama, and Florida" (Bull. Amer. Assoc. Petr. Geol., vol. 22, no. 8, pp. 984–1013, pls. 1–17, 1938), in which notes are given regarding the distribution and zonal value of a number of species of Camerinidae, and several species are figured.

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THE CACTUS-FEEDING PHYCITINAE: A CONTRIBUTION TOWARD A REVISION OF THE AMERICAN PYRALIDOID MOTHS OF THE FAMILY PHYCITIDAE

By CARL HEINRICH

INTRODUCTION

THIS paper is the first of a proposed series dealing with the American moths of the family Phycitidae. It is my intention to publish from time to time revisions of those groups that, in other orders, are usually designated as tribes, and to conclude with a general discussion of the family, synoptic keys to these groups and their genera, and, if circumstances permit, an illustrated catalog of the American species.

The cactus-feeding group is treated first because names are desired for certain undescribed species reared in connection with the investigations of the Commonwealth Prickly-Pear Board of Queensland. For several years A. P. Dodd and his associates on the board have been experimenting with cactus insects in an effort to eradicate or control the pricklypear in Australia. Apparently they have been successful. One phycitid species, *Cactoblastis cactorum* (Berg), has been liberated in Queensland and New South Wales and seems to have established itself and attacked the "pear" with phenomenal success. Mr. Dodd has in preparation a book dealing with the experiments of the board and the life histories of the insects they have studied. It is largely in anticipation of that book that the present taxonomic paper is offered.

Eighteen genera, 46 species, and 2 varieties are here treated. Of these, 8 genera and 8 species are described as new. The genus *Zophodia* Hübner is included because, although not a cactus insect, its structural characters link it closely with the cactus-feeding group and also because a number of cactus phycitids either have been described in that genus or later referred to it. In addition to *Zophodia* itself there are a few species now listed in *Eumysia* Dyar and *Laetilia* Ragonot that share most of the structural characters of the cactus-feeding group. To the best of my knowledge, however, they are not cactus insects and belong to a different though closely allied group. They will be treated separately in a later paper.

I am greatly obliged to Alan P. Dodd and R. C. Mundell, of the Australian Prickly-Pear Board, for specimens, larval and adult, of the tropical species. Nearly all the reared material in this group from South America has come to the National collection from Mr. Dodd, Mr. Mundell, and Mr. Haywood or has been received through them. Mr. Dodd also has sent me his unpublished notes on the distribution, food plants,[1] and larval habits of the tropical species. With his permission I am using such of this information as is needed for purely taxonomic purposes. His forthcoming book will contain more detailed accounts of the various species, their life histories and earlier stages.

The Phycitidae is a family of prime economic importance. For its size it probably contains a greater percentage of species of concern to the economic entomologist than any other family of the Lepidoptera. It is important, therefore, that its members be classified in something approaching a natural order, that the genera and their grouping conform to the facts of biology and host relationship, and that larvae and unassociated females may be identified as well as the male moths. In the cactus-feeding group, as also in some other groups, we have enough information to attempt such a classification; and in future papers I hope to be able to follow through the scheme here adopted, namely, a definition of genera based upon adult and, as far as they are known, larval structural characters, host associations, wing pattern, and biology. I do not flatter myself with the thought that I shall entirely succeed; but the trial at least is imperative.

At present the classification of the Phycitinae is a hopeless muddle. No one seems to know just what a generic concept stands for or to what genus a given species (which is not a genotype) should go. This is not so much the fault of any entomologist as it is of the phycitids themselves. The family is a fluid one. There are few obvious, hard-and-fast divisions anywhere, nor can real divisions, when established, be defined in simple, categorical terms; for there

[1] Plant names used in this paper follow Britton and Rose, "The Cactaceae," Carnegie Inst. Washington Publ. 248, vols. 1–4, 1919–1923.

is hardly a single structural character that does not break down somewhere. In any large series of any given species there are specimens wherein the venation, for example, varies from that of the genus or the larger group. The palpal characters grade into one another by almost imperceptible degrees and are apt to explode altogether. For example, a perfectly good *Dioryctria* may have an aigrettelike male maxillary palpus (which should place it in *Salebria*) while its most closely related species and one hardly distinguishable otherwise may have a perfectly normal squamous palpus. The male of one species may have a short cell and seven veins in the hind wing while its female exhibits a long cell and eight veins. Wing pattern and color also vary to some extent but on the whole are more reliable for specific placement than are venational, palpal, or antennal characters for genera. The genitalia, both male and female, seem to be more constant than other structures and to offer the best characters for the identification of species and genera; but they, too, must be used with caution. A classification based upon them alone would be as misleading as any other.

Up to the present only one serious and noteworthy attempt has been made to classify the family, that of Ragonot in his monumental "Monographie des Phycitinae et des Galleriinae."[2] He left the second volume unfinished at his death, but Hampson completed it from his notes, and Hampson himself was working on a generic revision of the Phycitinae when he retired from active entomological work. Ragonot's system was based chiefly upon venation, palpal structure, vestiture, and secondary male characters. In its broader outlines it was a natural classification; but its great reliance upon secondary male characters made it unworkable for unassociated females; and many species were then and later described from such females and had to be placed by guesswork. The genera themselves were more or less artificial entities and (except for the monotypic genera and some with very few species) usually included species not closely related to one another or not conforming on all definitive characters.

Hulst, who worked contemporaneously with Ragonot, followed, in his own careless fashion, the Ragonot system. He made some attempt to use the male genitalia, but his observations were entirely superficial and sporadic, and his statements concerning these structures are more often misleading than not. Dyar, Hampson, Meyrick, Caradja, and later authors have published only descriptions of new genera and species. Dr. A. J. T. Janse has made an extensive study of the South African Phycitidae and has given special attention to

[2] Mémoires sur les Lépidoptères, vol. 7, 1893; vol. 8, 1901.

the genitalia. He probably knows the family better than any living lepidopterist, but as yet he has not published any revisionary work on it.

From my own studies I feel that the only possible way to get a classification that will permit of workable keys and the ready identification of moths of both sexes is to make small genera, to limit them to only obviously related species, to define them rigidly, and in the definition to utilize every available character of structure, habitus, and biology. I do not suggest that I have done this here or shall be able to do it in future papers on the group; but such is the ideal.

Family PHYCITIDAE

Subfamily PHYCITINAE

Adult.—Labial palpus well developed. Maxillary palpus always present. Tongue developed; basal portion scaled. Fore wing entire (not divided); 11 veins or less; 7 absent; 8 and 9 stalked or united; 1c absent (represented by a fold or crease in the wing membrane); no areole. Hind wing with 8 veins or less; 8 closely approximate to, anastomosing or completely fusing with 7 beyond cell; 1c always present; a fringe of pecten on lower median vein at base; frenulum of female simple (a single strong spine).

Larva.—With primary setae only; two setae on prespiracular shield of prothorax; IV and V approximate and under the spiracle on abdominal segments 1 to 8; a sclerotized, pigmented ring encircling or partially encircling the tubercle of seta IIb on mesothorax and a similar ring encircling tubercle of seta III of eighth abdominal segment [this character absent from *Etiella zinckenella* (Treitschke) and *Ulophora grotei* (Ragonot)]. Prolegs normal; crochets in a complete circle.

GENERAL CHARACTERS OF THE CACTUS-FEEDING GROUP

Adult.—Antenna pectinate or pubescent; sometimes with modified setae on the basal segments or pectinations of the shaft, but never with sinus and strong scale tuft; basal segment simple. Labial palpus upturned, oblique or porrect, stout; third segment always exposed, never longer than second. Maxillary palpus alike in both sexes; usually squamous (with the scales spread on third segment), rarely filiform (fig. 134a) or flamboyant (fig. 126); never otherwise modified. Front rounded, the scales either appressed or conically projecting. Fore wing smooth, oblong, broadest toward termen; termen vertical or slanting; color blue-gray, grayish fuscous, whitish ocherous, or ocherous-fuscous, with dark markings fuscous or black,

color alike in both sexes; 11 veins, 10 from the cell, 4 and 5 stalked, 2 and 3 from near lower outer angle of cell, approximate or separate; no costal fold or other secondary sexual modifications. Hind wing with 7 veins; 7 and 8 approximate or anastomosing beyond cell (never completely fused); 3 and 5 connate or stalked; 4 absent; 2 from cell before (but near) lower outer angle; no sex scaling or other sexual modifications; structurally alike in both sexes; color white in the male (except in *Cactoblastis bucyrus* Dyar), white to fuscous in the female; cell about one-half the length of wing. Abdomen of male with a pair (rarely two pairs) of ventrolateral hair tufts at base of eighth segment or with eighth segment simple.[8]

Male genitalia with uncus broad, subtriangular, never hook-shaped or otherwise modified; the lateral edges sometimes slightly sinuate or concave; apex rounded; outer (dorsal) surface densely covered with bristlelike scales. Gnathos terminating in a flanged and hooked apical process, which is normally bifid but sometimes fused. Transtilla represented by a pair of separate, more or less elongate, and triangular plates; never forming a bridge or otherwise modified. Harpe simple, without clasper or extensions from sacculus or costa; apex broadly or obliquely rounded, rarely bluntly pointed (*Tucumania tapiacola* Dyar). Anellus U-shaped, either flat or slightly curved, the lateral arms often twisted slightly to rest against the lateral sides of the aedeagus, but otherwise unmodified. Aedeagus straight or slightly sinuate; usually smooth, but occasionally with a few very small scobinations at apex. Penis smooth, finely scobinate or with sclerotized wrinklings but not otherwise armed. Vinculum stout and broad, short or long, with terminal margin normally broadly rounded.

Female genitalia with bursa copulatrix membranous, smooth or with very minute scobinations on inner surface; signum frequently absent, when present consisting of a small ribbed, weakly serrate, finely scobinate or cupped plate; bursa never strongly sclerotized or pigmented. Ductus bursae membranous throughout, never strongly sclerotized; gradually widening into and not sharply differentiated from bursa copulatrix. Genital opening normally simple, sometimes minutely scobinate, rarely with sclerotized dorsal or ventral plates or a few setae on the inner surfaces of the ductus bursae at the opening; otherwise unmodified or unarmed. Ductus seminalis from bursa or, rarely, from ductus bursae near junction with bursa.

Larvae.—Internal feeders in the fruits and stems of various cacti.

[8] The eighth segment is considered to be simple when the sternite and tergite appear merely as flat narrow sclerotized plates (compare figs. 8d, 17d, 21d) and are not developed into sclerotized pockets or projecting processes, and when sensory hair tufts are absent.

KEY TO THE GENERA

For convenience of identification separate generic keys are given for males and females.

MALES

1. Maxillary palpi squamous or flamboyant 2
 Maxillary palpi filiform 16
2. Hind wing with veins 3 and 5 connate (rarely, very shortly stalked) 3
 Hind wing with veins 3 and 5 definitely stalked 5
3. Hind wing with veins 7 and 8 approximate; antenna bipectinate; aedeagus smooth 4
 Hind wing with veins 7 and 8 shortly anastomosed; antenna pubescent; apex of aedeagus finely spined 3. **Olyca** Walker
4. Labial palpus obliquely ascending 2. **Olycella** Dyar
 Labial palpus porrect 1. **Melitara** Walker
5. Eighth abdominal segment simple 6
 Eighth abdominal segment with paired tufts 13
6. Antenna bipectinate 7
 Antenna pubescent 8
7. Maxillary palpus not extending above middle of face (United States and Mexico) 4. **Alberada**, new genus
 Maxillary palpus extending above middle of face (South America) 5. **Nanaia**, new genus
8. Apical process of gnathos partially or completely fused 9
 Apical process of gnathos bifid 11
9. Apical process of gnathos partially fused 6. **Cactoblastis** Ragonot
 Apical process of gnathos completely fused 10
10. Harpe without subbasal sclerotized pocket; anellus with base of plate narrowly sclerotized; aedeagus moderately long and sclerotized throughout 7. **Cahela**, new genus
 Harpe with subbasal sclerotized pocket; anellus with base of plate broadly sclerotized; aedeagus short and partially sclerotized 8. **Rumatha**, new genus
11. Labial palpus porrect 9. **Yosemitia** Ragonot
 Labial palpus upturned 12
12. Anellus with arms rather long; aedeagus smooth 10. **Tucumania** Dyar
 Anellus shieldlike, with the arms short; aedeagus with a minutely scobinate flange at apex 11. **Eremberga**, new genus
13. Antenna pubescent 14
 Antenna unipectinate 13. **Parolyca** Dyar
 Antenna bipectinate 15
14. Antenna with basal segments of shaft bearing papillalike setae. 16. **Ozamia** Ragonot
 Antenna without such setae on shaft 12. **Salambona**, new genus
15. Maxillary palpus flamboyant, reaching well above middle of face. 14. **Sigelgaita**, new genus
 Maxillary palpus squamous, not reaching above middle of face. 15. **Amalafrida**, new genus
16. Antenna pectinate or serrate and pubescent; labial palpus upcurved 17. **Cactobrosis** Dyar
 Antenna simple and pubescent; labial palpus oblique 18. **Zophodia** Hübner

FEMALES

1. Maxillary palpi squamous or flamboyant 2
 Maxillary palpi filiform 16
2. Hind wing with veins 3 and 5 connate (rarely very shortly stalked) 3
 Hind wing with veins 3 and 5 definitely stalked 5
3. Hind wing with veins 7 and 8 approximate; antenna bipectinate 4
 Hind wing with veins 7 and 8 shortly anastomosed; antenna pubescent 3. **Olyca** Walker
4. Bursa without signum 1. **Melitara** Walker
 Bursa with signum 2. **Olycella** Dyar
5. Labial palpus porrect 6
 Labial palpus obliquely ascending 16. **Ozamia** Ragonot
6. Maxillary palpi flamboyant 14. **Sigelgaita**, new genus
 Maxillary palpi squamous 7
7. Bursa with signum 8
 Bursa without signum 13
8. Signum a small, shortly spined plate 9. **Yosemitia** Ragonot
 Signum otherwise 9
9. Ductus seminalis from middle of bursa copulatrix 4. **Alberada**, new genus
 Ductus seminalis from bursa near or at junction of bursa and ductus bursae 10
10. Ductus seminalis from bursa at junction of bursae and ductus bursae, remote from signum 6. **Cactoblastis** Ragonot
 Ductus seminalis from bursa near (but not at) junction of bursa and ductus bursae, more or less approximate to signum 11
11. Habitat, South America 10. **Tucumania** Dyar
 Habitat, southwestern part of United States and northern Mexico 12
12. Dark markings on fore wing longitudinal; no discal spot. 7. **Cahela**, new genus
 Dark markings on fore wing transverse (at least in part); discal spot prominent 8. **Rumatha**, new genus
13. Ductus seminalis from ductus bursae 11. **Eremberga**, new genus
 Ductus seminalis from middle or from near end of bursa copulatrix 14
14. Bursa copulatrix large 15. **Amalafrida**, new genus
 Bursa copulatrix small 15
15. Ductus bursae finely scobinate at genital opening 5. **Nanaia**, new genus
 Ductus bursae smooth at genital opening 12. **Salambona**, new genus
16. Labial palpus oblique; bursa copulatrix large, without signum. 17. **Cactobrosis** Dyar
 Labial palpus porrect; bursa copulatrix small, with signum. 18. **Zophodia** Hübner

LIST OF GENERA AND SPECIES

1. *Melitara* Walker
 1. *prodenialis* Walker
 2. *dentata* (Grote)
2. *Olycella* Dyar
 1. *junctolineella* (Hulst)
 2. *junctolineella pectinatella* (Hampson)
 3. *nephelepasa* (Dyar)
 4. *subumbrella* (Dyar)
3. *Olyca* Walker
 1. *phryganoides* Walker
4. *Alberada*, new genus
 1. *parabates* (Dyar)
 2. *bidentella* (Dyar)
 3. *holochlora* (Dyar)
5. *Nanaia*, new genus
 1. *substituta*, new species

6. *Cactoblastis* Ragonot
 1. *cactorum* (Berg)
 2. *ronnai* (Brèthes)
 3. *doddi*, new species
 4. *mundelli*, new species
 5. *bucyrus* Dyar
7. *Cahela*, new genus
 1. *ponderosella* (Barnes and McDunnough)
8. *Rumatha*, new genus
 1. *glaucatella* (Hulst)
 2. *bihinda* (Dyar)
 3. *polingella* (Dyar)
9. *Yosemitia* Ragonot
 1. *graciella* (Hulst)
 2. *longipennella* (Hulst)
 3. *fieldiella* (Dyar)
 4. *didactica* Dyar
10. *Tucumania* Dyar
 1. *tapiacola* Dyar
 2. *porrecta* Dyar
11. *Eremberga*, new genus
 1. *leuconips* (Dyar)
 2. *creabates* (Dyar)
 3. *insignis*, new species
12. [illegible]
 1. *analamprella* (Dyar)
13. *Parolyca* Dyar
 1. *asthenosoma* (Dyar)
14. *Sigelgaita*, new genus
 1. *chilensis*, new species
 2. *huanucensis*, new species
 3. *transilis*, new species
15. *Amalafrida*, new genus
 1. *lethella* (Dyar)
16. *Ozamia* Ragonot
 1. *lucidalis* (Walker)
 2. *odiosella* (Hulst)
 3. *odiosella fuscomaculella* (Wright)
 4. *thalassophila* Dyar
 5. *stigmaferella* (Dyar)
 6. *hemilutella* Dyar
 7. *punicans*, new species
17. *Cactobrosis* Dyar
 1. *fernaldialis* (Hulst)
 2. *longipennella* (Hampson)
 3. *maculifera* Dyar
 4. *insignatella* Dyar
 5. *strigalis* (Barnes and McDunnough)
18. *Zophodia* Hübner
 1. *convolutella* (Hübner)

1. Genus MELITARA Walker

Melitara Walker, List of specimens of lepidopterous insects in the collection of the British Museum, vol. 27, p. 136, 1863.—Hulst, Trans. Amer. Ent. Soc., vol. 17, p. 171, 1890.—Ragonot, Mémoires sur les Lépidoptères, vol. 8, p. 12, 1901.—Dyar, Proc. Ent. Soc. Washington, vol. 30, p. 133, 1928. (Genotype: *Melitara prodenialis* Walker.)

Megaphycis Grote, Can. Ent., vol. 14, p. 30, 1882. (Genotype: *Zophodia bollii* Zeller.)

Antenna of male bipectinate, of female shortly bipectinate. Labial palpus porrect. Maxillary palpus squamous. Hind wing with veins 7 and 8 approximate beyond cell; 3 and 5 connate (rarely very shortly stalked). Eighth abdominal segment of male simple.

Male genitalia with apical process of gnathos bifid; harpe with apex evenly rounded; vinculum short; anellus with base of plate narrowly sclerotized, arms moderately long and stout; aedeagus stout, moderately long.

Female genitalia without signum, the latter replaced by a few very fine scobinations (not distinguishable in most preparations except under high magnification), bursa copulatrix otherwise simple; ductus seminalis from bursa near junction of ductus bursae and bursa copulatrix.

Larva bluish, not banded; sclerotic plates surrounding body setae rather small; 3 setae in group VII on abdominal segments 7 and 8.

The larvae feed gregariously in the joints of various species of *Platypuntia.*

Eggs laid in chains.

Remarks.—The genus as here defined is separated from other cactus-feeding phycitids by the following combination of characters: Antennae pectinate in both sexes; labial palpi porrect in both sexes; veins 7 and 8 of hind wing approximate; veins 3 and 5 of hind wing connate; eighth abdominal segment of male simple; larvae not banded or conspicuously spotted, gregarious in habit throughout feeding period.

Two species only are recognized as belonging to the genus, and its distribution is apparently limited to the United States and adjacent areas in northern Mexico.

KEY TO THE SPECIES OF MELITARA

1. Subterminal dentate line of fore wing with a rather shallow angulation between veins 5 and 6 1. prodenialis Walker
 Subterminal dentate line of fore wing with a deep angulation between veins 5 and 6 2. dentata (Grote)

1. MELITARA PRODENIALIS Walker

PLATES 23, 36, 44, 45; FIGURES 1–1f, 41–41a, 81, 83–83a, 84

Melitara prodenialis WALKER, List of specimens of lepidopterous insects in the collection of the British Museum, vol. 27, p. 137, 1863.—HULST, Trans. Amer. Ent. Soc., vol. 17, p. 171, 1890; U. S. Nat. Mus. Bull. 52, p. 429, 1903.—RAGONOT, Mémoires sur les Lépidoptères, vol. 8, p. 13, 1901.—HUNTER, PRATT, and MITCHELL, Bur. Ent., U. S. Dept. Agr., Bull. 113, p. 28, 1912.—BARNES and MCDUNNOUGH, Check list of the Lepidoptera of Boreal America, no. 5693, 1917.—DODD, Council for Scientific and Industrial Research, Australia, Bull. 34, p. 27, 1927.—DYAR, Proc. Ent. Soc. Washington, vol. 30, p. 133, 1928.

Zophodia bollii ZELLER, Verh. zool.-bot. Ges. Wien, p. 550, pl. 3, fig. 21, 1872.

Megaphycis bollii (Zeller) GROTE, Can. Ent., vol. 14, p. 30, 1882.

Melitara prodenialis bollii (Zeller) DYAR, Proc. Ent. Soc. Washington, vol. 30, p. 133, 1928.

Melitara Bollii (Zeller) DODD, Council for Scientific and Industrial Research, Australia, Bull. 34, p. 29, 1927.

Male.—Palpi, head, and thorax cinereous-fuscous sparsely dusted with white, especially on basal segments of labial palpi; posterior margin of thorax blackish. Fore wing cinereous-fuscous with a heavy dusting of white on costal half; the fuscous and whitish areas contrasted but not sharply defined, the white dusting most pronounced between antemedial and subterminal lines and in subapical

area beyond subterminal line; a few black scales scattered over entire wing; antemedial line narrow, black, outwardly angled from basal fourth of costal margin, the apex of angle at vein 1b, strongly marked from costal margin to 1b, less sharply defined from there to inner margin; subterminal line narrow, black, outwardly margined by a narrow border of white, beyond which is a faintly dark shading which forms an obscure line paralleling the subterminal line, the parallel black lines most pronounced from costal margin near apex to vein 6; subterminal line irregularly dentate and sinuate, the angulations rather shallow; discal dots fused, forming a black line or smudge along discocellular vein; a row of black dots along termen at the vein ends; cilia grayish fuscous; underside of wing grayish fuscous, in some specimens with a more ocherous tint. Hind wing white, semihyaline with more or less fuscous suffusion at apex and along costal and terminal margins; cilia white with a narrow, dark, subbasal line.

Alar expanse, 31–38 mm.

Genitalia (figs. 1–1f) with outer margins of vinculum evenly curved; elements of transtilla rather broad.

Female.—Similar to the male except that pectinations of antenna are much shorter (fig. 84), and fuscous shadings on hind wings are more extended.

Alar expanse, 35–45 mm.

Genitalia (figs. 41–41a) with ductus bursae rather slender for most of its length.

Types.—In British Museum (*prodenialis*); in Cambridge Museum of Natural History (*bollii*).

Type localities.—"United States" (*prodenialis*); Texas (*bollii*).

Food plants.—*Opuntia* (*Platypuntia*) spp.

Distribution.—UNITED STATES: *Texas*, Dallas, Freeport, Utopia, College Station (Oct.), Brownsville; *Mississippi*, Biloxi (Sept.); *Oklahoma*, Wichita National Forest (June); *Florida*, Altamont (Sept., Oct.), Key West, Lakeland (Apr.), Crescent City (May), Miami (Oct.), St. Petersburg (March, June, Sept., Oct.), Fort Meade (Apr.), Fort Myers (Apr.), Venice (May); *North Carolina*, Southern Pines (June); *Delaware*, Indian River Bay (July); *New Jersey*, Lakehurst (Sept.); *New York*, Rye (July).

Eighty-two specimens examined.

Remarks.—Hulst, Ragonot, and, for several years, Dyar regarded *bollii* as nothing more than a synonym of *prodenialis*, and it has so appeared in our lists. Dodd treated it as a distinct species and applied the name to specimens from a restricted area in southern Texas. In a letter dated July 7, 1936, he writes me that "what we call *M. bollii* is a form with certain constant differences in habits and life-cycle

which attacks *O. lindheimeri* in the Laredo-Uvalde section of Texas. On the Gulf coast of Texas the *Melitara* attacking *O. lindheimeri* and other pricklypears we consider to be *prodenialis*, identical with Florida *prodenialis*. Hence we would continue to retain the Laredo-Uvalde insect as a distinct form." Upon similar information from Dodd, Dyar, in 1928, removed *bollii* from synonymy but did not give it full specific rank. He characterized the supposed race as follows: "Smaller than *prodenialis*, whiter and smoother, from Texas."

I am unable to see these distinctions and can find nothing in structure, color, or size to distinguish pinned specimens of the supposed *bollii* from equally small specimens of typical *prodenialis*. There may be a biological race or strain in southern Texas that can be distinguished in the field; but, if so, it is doubtful if the name *bollii* can be applied to it; for Boll's specimens (from which Zeller described his species) were collected in the neighborhood of Dallas, well north of the range of the supposedly distinct form.

Descriptions of eggs and larvae and a brief note on the life history are given in the Hunter, Pratt, and Mitchell bulletin.

2. MELITARA DENTATA (Grote)

PLATES 23, 36, 45; FIGURES 2–2c, 40, 85–85a, 86–86a

Zophodia dentata GROTE, Can. Ent., vol. 8, p. 158, 1876; Bull. U. S. Geol. and Geogr. Surv. Terr., vol. 3, p. 799, 1877.

Megaphycis dentata (GROTE), Can. Ent., vol. 14, p. 30, 1882.

Melitara dentata (Grote) HULST, Trans. Amer. Ent. Soc., vol. 17, p. 172, 1890; U. S. Nat. Mus. Bull. 52, p. 429, 1903.—KELLOGG, Kansas Univ. Quart., vol. 1, p. 39, 1892.—RAGONOT, Mémoires sur les Lépidoptères, vol. 8, p. 14, 1901.—HUNTER, PRATT, and MITCHELL, Bur. Ent., U. S. Dept. Agr., Bull. 113, p. 28, 1912.—BARNES and MCDUNNOUGH, Check list of the Lepidoptera of Boreal America, no. 5694, 1917.—DODD, Council for Scientific and Industrial Research, Australia, Bull. 34, p. 29, 1927.—DYAR, Proc. Ent. Soc. Washington, vol. 30, p. 134, 1928.

Melitara doddalis DYAR, Insecutor Inscitiae Menstruus, vol. 13, p. 13, 1925; Proc. Ent. Soc. Washington, vol. 30, 134, 1928.—DODD, Council for Scientific and Industrial Research, Australia, Bull. 34, p. 29, 1927. (New synonymy.)

Melitara junctolineella HULST (in part), Can. Ent., vol. 32, p. 173, 1900.—BARNES and MCDUNNOUGH, Contr. Nat. Hist. Lepid. North America, vol. 3, no. 3, p. 199, 1916.

Male.—General color and pattern as in *prodenialis* except as follows: Blackish shading on posterior margin of thorax less pronounced and in some specimens not distinguishable. Fore wing with white dusting rather evenly distributed over the entire wing, the whitish and fuscous areas not contrasted except (in some specimens) for a rather narrow pale suffusion along costal margin and a more or less pronounced dark shade from end of cell to middle of inner

margin; the subterminal line with no black shading beyond its white border except for a short distance from apex, markedly dentate and sinuate, the angulations deep, *the angulation between veins 5 and 6 reaching to the cell.* Hind wing semihyaline, almost pure white with little or no fuscous shading, the latter, when present, confined to a narrow band along costal margin and a fine line along termen; cilia white.

Alar expanse, 33–43 mm.

Genitalia (figs. 2–2c) with outer margins of vinculum slightly sinuate; elements of transtilla slightly narrower than those of *prodenialis.* Slight differences in the shape of the anellus in the two species are shown in figures 1d and 2b.

Female.—Similar to the male except that the pectinations of the antenna are shorter, the maxillary palpus is longer and the fuscous shadings are nearly always pronounced on the hind wing, though limited to a narrow border along the costal margin, a slight clouding at apex, and a thin line along the termen.

Alar expanse, 35–50 mm.

Genitalia (fig. 40) essentially like those of *prodenialis* except that the ductus bursae is normally stouter.

Types.—In British Museum (*dentata*); in United States National Museum (*doddalis*).

Type localities.—Clear Creek Canyon, Colo. (*dentata*); Mesilla Park, N. Mex. (*doddalis*).

Food plants.—*Opuntia* (*Platypuntia*) spp.

Distribution.—UNITED STATES: *Colorado*, Glenwood Springs (July, Aug., Sept.), Fort Collins, Denver, Rocky Ford (Sept.); *Utah*, Buckskin Valley (Iron County, June, July), Eureka (Aug.), Dividend (Aug., Sept.); *Kansas*, Manhattan (Sept.); *Arizona*, Mormon Lake (July), Douglas (Aug., Sept.), Oracle (Sept.), Globe (Sept.), Quijotoa Mountains (Oct.), Chiricahua Mountains; *New Mexico*, Mesilla Park (Sept.), Silver City (Sept.), Julimes (Sept., Oct.), Jemez Springs (July, Aug., Sept.); *Texas*, Uvalde (Sept., Oct., Nov.), Henrietta (Oct.), Trent (Oct.), Rock Springs, Laredo (Sept.), Shafter (Sept.), Albany, Panhandle (Aug.). MEXICO: Chihuahua City, Morelia (Oct.).

One hundred and forty specimens examined.

Remarks.—In his description of *doddalis*, Dyar pointed out a number of supposed differences in genitalic and palpal structure between his species and *dentata.* These differences are entirely imaginary. There is not a structural character separating the two forms. There are some slight color differences between specimens from Colorado and specimens from Texas, Arizona, and New Mexico. The latter seem to have a slightly denser dusting of white scales on the fore wing and

consequently appear somewhat more ashy gray than the Colorado specimens; but this pale suffusion also shows in Kansas specimens and in a number of those from Utah.

Dodd has also treated *doddalis* and *dentata* as separate species. He writes: "In our concept, *M. doddalis* is distinct from *M. dentata.* We would give the distribution of *dentata* from the Panhandle of Texas across to northern Arizona, north through Colorado, Utah, and Kansas to Idaho and Wyoming. *M. doddalis* occurs through western Texas and New Mexico to southern Arizona."

Possibly there may be local races involved, but if so their distribution does not correspond with any consistent differences in color or habitus, for, as stated, the Kansas specimens that fall within the supposed *dentata* area are more like typical *doddalis* than they are like Colorado *dentata.*

I think that the two names apply to nothing more than local variants of one rather variable species.

Descriptions of the egg, larva, and pupa are given in the paper by Kellogg.

As pointed out by Barnes and McDunnough, the female paratypes of *junctolineella* (from Colorado) are not conspecific with the male type (from Texas) but must be referred here. One of these paratypes is now in the National collection.

2. Genus OLYCELLA Dyar

Olycella Dyar, Proc. Ent. Soc. Washington, vol. 30, p. 134, 1928. (Genotype: *Melitara junctolineella* Hulst.)

Antenna of male bipectinate, of female shortly bipectinate. Labial palpus obliquely ascending (sometimes in the female the third segment is bent forward, which gives the palpus a porrect appearance, but the second segment is always deflected upward and reaches nearly as high as the top of the head). Maxillary palpus squamous. Hind wing with veins 7 and 8 approximate beyond the cell; 3 and 5 connate. Eighth abdominal segment of male simple.

Male genitalia with apical process of gnathos bifid; harpe with apex evenly rounded; vinculum short; anellus with base of plate narrowly sclerotized, arms moderately long and stout; aedeagus stout, moderately long.

Female genitalia with signum, the latter a small ridged plate; bursa copulatrix wrinkled, otherwise simple and without scobinations; ductus bursae with a pair of sclerotized plates on inner wall at genital opening; ductus seminalis from center of bursa.

Larva white with broad blackish or purplish cross bands on the caudal margins of the segments; sclerotized plates surrounding setae rather small; three setae in group VII on abdominal segments 7 and 8.

The larvae feed gregariously for a short period after hatching (probably during the first instar) but thereafter are solitary in habit. They feed in the joints of various Platypuntias.

Remarks.—In his description of the genus Dyar gives the male palpi as upturned and those of the female as oblique. Strictly speaking they are obliquely upturned in both sexes, though in many females the third joints are bent forward, which gives the palps a porrect appearance. The genus is close to *Melitara* and distinguished from it only by the following characters: Labial palpi obliquely ascending; larvae transversely banded and solitary in habit during most of the feeding period.

Three species and one local race are here recognized. They are remarkably alike in structure, whatever differences in genitalia there may be between specimens being individual rather than specific. The species, however, can be distinguished easily enough by the characters given in the following key:

KEY TO THE SPECIES OF OLYCELLA

1. General color of fore wing ocherous-fuscous; hind tibia white with very little dark dusting 2
 General color of fore wing grayish fuscous; hind tibia heavily dusted with fuscous 3
2. Transverse markings of fore wing fairly distinct ... 1. junctolineella (Hulst)
 Transverse markings of fore wing obsolete. 2. junctolineella pectinatella (Hampson)
3. General color grayish with a slight brownish overtint (distribution, the central plateau of Mexico) 3. nephelepasa (Dyar)
 General color decidedly grayish (distribution, western Texas and Arizona to California and Utah) 4. subumbrella (Dyar)

1. OLYCELLA JUNCTOLINEELLA (Hulst)

PLATES 24, 36, 45; FIGURES 3–3c, 42–42a, 88–88a, 89–89a

Melitara junctolineella HULST, Can. Ent., vol. 32, p. 173, 1900; U. S. Nat. Mus. Bull. 52, p. 429, 1903.—HUNTER, PRATT, and MITCHELL, Bur. Ent., U. S. Dept. Agr., Bull. 113, p. 25, 1912.—BARNES and MCDUNNOUGH, Contr. Nat. Hist. Lepid. North America, vol. 3, no. 3, p. 199, 1916.—DODD, Council for Scientific and Industrial Research, Australia, Bull. 34, p. 27, 1927.

Olyca junctolineella (Hulst) BARNES and MCDUNNOUGH, Check list of the Lepidoptera of Boreal America, no. 5695, 1917.

Olycella junctolineella (Hulst) DYAR, Proc. Ent. Soc. Washington, vol. 30, p. 134, 1928.

Male.—Head, thorax, and fore wings ocherous-fuscous dusted with white and marked with patches and lines of black scales. Labial palpus with the apical ends of the segments blackish. Maxillary palpus cross-banded with black scales. Thorax with some black dusting on posterior margin. Fore wing with whitish dusting slightly intensified in costal

area; veins faintly outlined in black; a row of more or less obscure black dots on termen between the vein ends; antemedial line interrupted, sometimes obscure, in fresh, well-marked specimens its outer dentation much extended and meeting a shade from the inner angulation of the subterminal line at the fold (which indicates the normal position of the absent vein 1c); subterminal line interrupted, strongly indicated only between veins 5 and the fold and for a short distance from inner margin; black discal dots at end of cell more or less fused and pronounced; cilia ocherous-fuscous. Hind wing pure white.

Alar expanse, 38–45 mm.

Male genitalia as figured (figs. 3–3c). The genitalia (male and female) present no outstanding specific characters.

Female.—Similar to the male except that the antennal pectinations are shorter, the labial palpi appreciably longer, the fore wings a trifle darker, and the hind wings generally suffused with fuscous, the intensity of the fuscous shade differing in different specimens.

Alar expanse, 45–55 mm.

Female genitalia as figured (figs. 42–42a).

Type.—In Rutgers College collection.

Food plants.—*Opuntia* (*Platypuntia*) spp.

Distribution.—UNITED STATES: *Texas*, Brownsville (Apr., June, July, Aug.), Corpus Christi (Sept., Oct.), Burnet County, San Benito (Mar., Aug., Sept.), Shovel Mountain (May), Kerrville (Apr.), Victoria (Oct., Nov.), Laredo (Sept).

Forty-one specimens examined.

Remarks.—This species is most readily distinguished from the others in the genus by its ocherous-fuscous color, which seems to be constant. It is remarkably so in the specimens before me. *O. nephelepasa* and *subumbrella* are decidedly gray in appearance.

Rather full notes on the life history and larval habits of *junctolineella* are given in Dodd's bulletin and the bulletin by Hunter, Mitchell, and Pratt. The latter also contains descriptions of the larva and pupa.

2. OLYCELLA JUNCTOLINEELLA PECTINATELLA (Hampson)

PLATE 24, FIGURE 4

Olyca pectinatella HAMPSON, Mémoires sur les Lépidoptères, vol. 8, p. 35, 1901.
Olyca junctolineella (Hulst) BARNES and MCDUNNOUGH, Check list of the Lepidoptera of Boreal America, no. 5695, 1917 (in part).
Olycella junctolineella (Hulst) DYAR, Proc. Ent. Soc. Washington, vol. 30, p. 134, 1928 (in part).

In removing *pectinatella* from the synonymy of *junctolineella*, where it was placed by Barnes and McDunnough and by Dyar, I am doing so chiefly as a precautionary measure. Hampson described his

species from a single collected male. There is one other male in the National collection from the type locality. These two specimens are a trifle paler than normal *junctolineella* and are less clearly marked except for the pronounced discal spots. The transverse lines on the fore wing are almost obsolete and the veins very slightly indicated by dark shading.

Inasmuch as we have no larvae or females, or any information on the life history of the form from Jalapa (which is far south of the known range of typical *junctolineella*), I do not think we are justified in treating it as a mere synonym; or, on the evidence before us, as a distinct species.

Type.—In United States National Museum.

Type locality.—Jalapa, State of Veracruz, Mexico.

Known only from the two males from the type locality.

8. OLYCELLA NEPHELEPASA (Dyar)

PLATE 45, FIGURES 87–87a

Olyca nephelepasa DYAR, Insecutor Inscitiae Menstruus, vol. 7, p. 55, 1919.
Olycella nephelepasa (DYAR), Proc. Ent. Soc. Washington, vol. 30, p. 134, 1928.

Male.—Similar in pattern and general appearance to *junctolineella;* but darker. The fore wing is grayish fuscous with a slight brownish tint, but decidedly more grayish brown than ocherous-fuscous. Also the hind tibiae of *nephelepasa* are heavily dusted with fuscous, while those of *junctolineella* are nearly pure white.

Alar expanse, 42–44 mm.

The male genitalia cannot be distinguished from those of *junctolineella.*

Female.—Similar to the male except pectinations of antennae much shorter, labial palpi longer, and hind wings fuscous rather than white and semihyaline.

Alar expanse, 45–52 mm.

Female genitalia essentially like those of *junctolineella.*

Type.—In United States National Museum.

Type locality.—Tehuacan, Mexico.

Food plants.—*Opuntia* (*Platypuntia*) spp.

Distribution.—MEXICO: Tehuacan (Sept.), Mexico City, Cuernavaca, Aguascalientes, San Luis Potosi (June).

Eleven specimens examined.

Remarks.—The known distribution of this species is confined to the central plateau of Mexico. In the National collection there is one female (determined as *nephelepasa*) from Monclova, Mexico. This specimen is colored like typical *subumbrella* and is, I think, only a southern example of that species.

OLYCELLA SUBUMBRELLA (Dyar)

PLATE 36, FIGURE 43

Olyca subumbrella DYAR, Insecutor Inscitiae Menstruus, vol. 13, p. 14, 1925.
Olycella nephelepasa (DYAR), Proc. Ent. Soc. Washington, vol. 30, p. 134, 1928 (in part).

Male.—Similar to that of *nephelepasa* except that the fore wing is less brownish and more grayish than that of *nephelepasa*. The general color is decidedly gray rather than brownish or ocherous.

Alar expanse, 40–52 mm.

Male genitalia as in *nephelepasa* and *junctolineella*.

Female.—Similar to that of *nephelepasa* but without the brownish overtint characteristic of the latter.

Alar expanse, 43–55 mm.

Female genitalia (figured from paratype from the type locality) like those of *junctolineella*. Figure 43 shows the extreme variation from typical *junctolineella;* but the differences in the shape of the sclerotized areas of the collar of the eighth segment and the length of the supporting rods of the collar are not specific. Every intergrade between this and typical *junctolineella* may be found in each of the species in the genus.

Type.—In United States National Museum.

Type locality.—Carlsbad, N. Mex.

Food plants.—*Opuntia* (*Platypuntia*) spp.

Distribution.—UNITED STATES: *Texas*, El Paso (Mar.); *New Mexico*, Carlsbad (Sept.); *Arizona*, Dewey, Redington, Palmerlee, Paradise (Cochise County, Mar., Apr., May, June), Douglas (May, Aug.), Pinal Mountains (Apr.), Hualapai Mountains (May); *California*, Warner (Sept.), Santa Clara (Apr.); *Utah*, Dividend (May, June), Stockton (May), Richfield (May); *Nebraska*, Scotts Bluff (June).

Sixty-three specimens examined.

Remarks.—In addition to the above there are before me two specimens from Monclova, Coahuila, Mexico (E. Mortensen collection, Sept. 1926), which probably are referable here. One (a male) was in the collection under *junctolineella*, the other (a female) under *nephelepasa*. The male is in very poor condition but obviously belongs with the female. The latter is in fair shape, and its color is that of typical *subumbrella*. More material is needed from northern Mexico before we can determine what species inhabits that region.

In 1928 Dyar sank *subumbrella* as a synonym of *nephelepasa;* but Mr. Dodd informs me that the larval habits of the two are quite different. As he expects to publish his biological notes on the cactus-feeding Lepidoptera, I shall not discuss these differences, except to say that they seem sufficient, coupled with the different distributions

of the two forms and their slight, but apparently consistent, color differences to warrant their separation. I am therefore removing *subumbrella* from synonymy.

3. Genus OLYCA Walker

Olyca WALKER, List of specimens of lepidopterous insects of the British Museum, vol. 11, p. 725, 1857.—HAMPSON, Mémoires sur les Lépidoptères, vol. 8, p. 34, 1901.—DYAR, Proc. Ent. Soc. Washington, vol. 30, p. 133, 1928. (Genotype: *Olyca phryganoides* Walker.)

Antennae pubescent in both sexes (the pubescence longer in the male than in the female), slightly serrate in the male. Labial palpus of the male obliquely ascending; of the female porrect and downcurved. Maxillary palpus squamous. Hind wing with veins 7 and 8 shortly anastomosed beyond cell; 3 and 5 connate (occasionally very shortly stalked). Eighth abdominal segment of male simple.

Male genitalia with apical process of gnathos bifid; harpe with apex evenly rounded; vinculum short; anellus with base of plate narrowly sclerotized, arms moderately long and stout; aedeagus stout, moderately long, apex armed with many minute, hairlike spines.

Female genitalia without signum; bursa copulatrix simple except for a few microscopic scobinations; ductus bursae short; ductus seminalis from bursa somewhat caudad of middle.

Larvae not banded, solitary in habit, feeding in Platypuntias (presumably in the stems).

Eggs unknown.

Remarks.—Olyca is readily separated from other genera of the cactus-feeding Phycitinae having veins 3 and 5 of hind wing connate by having the antennae pubescent in both sexes.

The male genitalia are similar to those of *Olycella*, differing only in slight details; the vinculum is slightly shorter, the uncus broader in proportion to its length, the cleft apical process of gnathos smaller, the elements of transtilla longer and straighter.

The females differ chiefly in that they lack the signum in the bursa and the sclerotized plates in the opening of the ductus bursae.

The genus as here defined contains only the type species from the West Indies.

1. OLYCA PHRYGANOIDES Walker

Plates 24, 37, 46; FIGURES 5–5c, 44–44a, 90, 91

Olyca phryganoides WALKER, List of specimens of lepidopterous insects of the British Museum, vol. 11, p. 726, 1857.—HAMPSON, Mémoires sur les Lépidoptères, vol. 8, p. 35, 1901.—DYAR, Proc. Ent. Soc. Washington, vol. 30, p. 134, 1928.

Male.—General color (except hind wings) pinkish white, more or less spotted and suffused with black. Palpi, thorax, and underside of body heavily dusted and shaded with black. Fore wing with no dis-

tinguishable antemedial line, the latter being replaced by two more or less transversely extended black spots; subterminal line only partially and faintly indicated, irregularly dentate; vein ends marked with blackish dots or dashes; black discal spot large, conspicuous; below the discal dot a more or less extended black smudge. Hind wing white; a very narrow blackish-fuscous shade on terminal margin and a slightly wider dark shade along costal margin; cilia white with a dark subbasal line.

Alar expanse, 35–40 mm.

Male genitalia figure from specimen from Azuda, Hispaniola.

Female.—Similar to the male except for the sexual differences in palpi and antennae noted in the generic description and for the broader diffusion of the dark areas on fore and hind wings. About three-fourths of the fore wing is suffused with black, the pinkish-white color being strongly contrasted and limited to a rather narrow area along the costa, with a triangular projection at the end of the cell; terminal area and a patch on inner margin opposite discal spot also pale, but duller and less contrasted than the costal color. Hind wing with fuscous terminal and costal dark shading somewhat broader than in the male; veins outlined by fuscous scaling.

Alar expanse, 45–47 mm.

Female genitalia as figured (figs. 44–44a); bursa copulatrix with a scattering of microscopic scobinations, otherwise simple; scobinations in genital opening stronger and more dense, also in genital opening a few fine setae (the latter probably constitute a generic character).

Eggs unknown.

Larva.—"Cream or buff colored, with dark spiracular markings" (Dodd).

Type.—In the British Museum.

Type locality.—Hispaniola.

Food plant.—*Opuntia* (*Platypuntia*) sp.

Distribution.—SANTO DOMINGO: Azuda (Jan.). HAITI: Port-au-Prince (Jan.).

Seven specimens examined.

Remarks.—Nothing has been published on the life history of this species, and presumably little is known about it. What information I have on the larvae and larval habits is from notes supplied by Mr. Dodd. The larvae are presumably solitary in habit and confined to the Platypuntias. The distribution of *phryganoides* is probably confined to the West Indies. Druce,[5] under the combination "*Euzophera phryganoides*," records it from two Mexican localities (Presidio and Jalapa); but this is an error. His figure suggests that what he iden-

[5] Biologia Centrali-Americana, Insecta, Lepidoptera—Heterocera, vol. 2, p. 285, 1896.

tified as *phryganoides* is one of the species of *Cactobrosis*. If the figure is anything like the specimens Druce had, they cannot be *phryganoides*.

4. ALBERADA, new genus

Genotype.—Melitara parabates Dyar.

Antenna of male bipectinate, of female pubescent. Labial palpus porrect and downcurved. Maxillary palpus squamous. Hind wing with veins 7 and 8 anastomosing beyond cell; 3 and 5 stalked. Eighth abdominal segment of male simple.

Male genitalia with apical process of gnathos bifid, the two prongs rather widely separated; harpe with the apex evenly rounded; vinculum short; anellus with base of plate narrowly sclerotized, arms moderately long and stout; aedeagus stout, weakly sclerotized in middle except on midventer.

Female genitalia with signum developed as a ridged plate; bursa copulatrix finely scobinate and wrinkled; ductus seminalis from middle of bursa.

Larvae bluish, not banded; solitary feeders in the joints of Cylindropuntias.

Eggs laid singly or in masses of two or three.

Remarks.—The genus is close to *Melitara*, differing in the following characters: Veins 7 and 8 of hind wing anastomosed, 3 and 5 stalked, aedeagus only partially sclerotized, apical process of gnathos with prongs well separated, bursa copulatrix with signum.

The distribution is apparently limited to Mexico and the southwestern part of the United States.

KEY TO THE SPECIES OF ALBERADA

1. General color cinereous-fuscous; expanse 35 mm and over.
 1. parabates (Dyar)

 General color pale ocherous-fuscous; expanse 25 mm or less.
 2. bidentella (Dyar)
 3. holochlora (Dyar)

1. ALBERADA PARABATES (Dyar)

PLATES 25, 37, 46; FIGURES 7–7c, 45–45a, 92–92a, 93–93a

Melitara parabates DYAR, Proc. U. S. Nat. Mus., vol. 44, p. 322, 1913; Proc. Ent. Soc. Washington, vol. 30, p. 134, 1928.—BARNES and MCDUNNOUGH, Contr. Nat. Hist. Lepid. North America, vol. 4, no. 2, p. 175, 1918.—DODD, Council for Scientific and Industrial Research, Australia, Bull. 34, p. 27, 1927.

Male.—Palpi, face, head, and thorax dark cinereous-fuscous, more or less dusted with dull ocherous; posterior margin of thorax blackish. Fore wing fuscous with area between lower vein of cell and costal margin and from antemedial to subterminal lines heavily

dusted with white; area between lower vein of cell and inner margin and from base to subterminal line suffused with ocherous-fuscous; on the middle of this area a more or less extended smudge of blackish brown; antemedial line black, bordered inwardly by a line of white scales, dentate and sinuate, a sharp dentation at vein 11, a longer one in the cell (extending nearly to middle of wing), another equally long and acute dentation at the fold, and two very slight dentations between 1b and inner margin; subterminal line black with a white outer border, dentate and sinuate, the angulations deep, the angulation between 5 and 6 reaching *almost* to cell; area beyond subterminal line dark fuscous, paler in some specimens; along termen a row of black dots at the vein ends; discal black dot at end of cell conspicuous in most specimens. Hind wing white, semihyaline; costal margin bordered with fuscous and a fine dark fuscous line on termen for a short distance from apex.

Alar expanse, 35–45 mm.

Genitalia (figs. 7–7c) over twice as large as those of *bidentella;* aedeagus more extensively sclerotized.

Female.—Similar to the male in color and markings except that, in many specimens, there is a somewhat stronger fuscous shading in the apical area of the hind wing. Labial palpi longer than those of the male.

Alar expanse, 36–48 mm.

Genitalia (figs. 45–45a) larger than those of the other species of the genus and with scobinations in bursa finer.

Eggs laid singly or in masses of two or three.

Type.—In United States National Museum.

Type locality.—Cerritos, San Luis Potosi, Mexico.

Food plants.—*Opuntia* (*Cylindropuntia*) *imbricata* (Haworth) and probably several other Cylindropuntias.

Distribution.—United States: *California*, San Diego, Warner (Sept.), Palm Springs (Apr.), Oceanside (Aug.), Riverside (Oct.); *Arizona*, Christmas (Gila County), Fort Grant (July), Oracle (July), Redington, Santa Catalina Mountains (Sept.), Baboquivari Mountains (Apr., June, July, Aug., Sept., Oct.), Sells P. O. (Indian Oasis, Apr.), Douglas (June, Sept.), Mohave County (Aug.); *Texas*, Presidio County (July), Brewster County. Mexico: San Luis Potosi, Cerritos (Aug.), Tamaulipas, Tula (June).

Ninety-five specimens examined.

Remarks.—The specimens before me are remarkably uniform in color and markings except for a male from Texas and two males from Riverside, Calif. These are darker than normal *parabates.* In the Riverside specimens there is no appreciable white dusting on head, thorax, or fore wing. The fore wing is almost entirely suffused with blackish scales, and the pale areas and lines (normally

white) are light ocherous-fuscous. The two specimens are otherwise normal and represent nothing more than an aberrant color form.

2. ALBERADA BIDENTELLA (Dyar)

PLATES 25, 37, 46; FIGURES 6–6c, 46, 95–95a, 96–96a

Zophodia bidentella DYAR, Proc. Ent. Soc. Washington, vol. 10, p. 114, 1908.
Eumysia bidentella (DYAR), Insecutor Inscitiae Menstruus, vol. 13, p. 221, 1925.

Male.—Much smaller and paler than that of *parabates* but with similar pattern, the ground color more ocherous than fuscous, the white dusting on fore wing heavier, the dentations of antemedial and subterminal lines shorter; discal dots distinct and not fused as is frequently the case in *parabates*.

Alar expanse, 20–24 mm.

Genitalia (figs. 6–6c) similar to those of *parabates* but much smaller and with central ventral part of aedeagus more narrowly sclerotized.

Female.—Similar to the male except for the normal sexual differences in antennae; the female palpi are little if any longer than those of the male.

Alar expanse, 19–23 mm.

Genitalia (fig. 46) appreciably smaller than those of *parabates;* bursa wrinkled and more coarsely scobinate.

Type.—In United States National Museum.

Type locality.—San Antonio, Tex.

Food plant.—Unknown.

Distribution.—UNITED STATES: *Texas*, San Antonio (July), San Benito (June, Aug., Sept.), Brownsville (June); *Arizona*, Phoenix, "route between Dewey and Salome."

Twenty-one specimens examined.

Remarks.—A uniformly marked and colored species, known only from collected specimens.

3. ALBERADA HOLOCHLORA (Dyar)

PLATES 37, 46; FIGURES 47, 94–94a

Zophodia holochlora DYAR, Insecutor Inscitiae Menstruus, vol. 13, p. 15, 1925.

This is probably a synonym or, at most, a variety of *bidentella.* The three females of the type series are the only specimens I have seen. They are a trifle smaller than typical *bidentella*, and there are some slight, though hardly significant, differences in the female genitalia (shown in figs. 46, 47). However, until males of *holochlora* are discovered and *bidentella* has been reared, it will be wiser to keep the two as separate species.

According to Mr. Dodd the larvae are solitary in habit and dark blue and the eggs laid singly.

Alar expanse, 18 mm.

Type.—In United States National Museum.

Type locality.—Uvalde, Tex.

Food plant.—Opuntia (*Cylindropuntia*) *leptocaulis* De Candolle.

5. NANAIA, new genus

Genotype.—Nanaia substituta, new species.

Antenna of male bipectinate; of female pubescent. Labial palpus obliquely porrect (second segment obliquely upturned nearly to top of face and third segment bent forward or slightly downcurved); third segment long (in the female as long as second segment), pointed in the male, blunt in the female. Maxillary palpus large, developed as a broad, curved, somewhat flattened tuft of scales which reaches well above middle of face. Hind wing with veins 7 and 8 anastomosing beyond cell; 3 and 5 stalked. Eighth abdominal segment of male simple.

Male genitalia with apical process of gnathos bifid, the two prongs narrowly separated; harpe with the apex somewhat tapering but bluntly rounded; vinculum moderately long (longer than broad); anellus with base of plate narrowly sclerotized, arms long, tapering and slightly twisted; aedeagus moderately stout, strongly sclerotized throughout.

Female genitalia without signum; ductus bursae and bursa copulatrix simple except for fine scobinations in ductus at genital opening; ductus bursae long; bursa copulatrix small; ductus seminalis from middle of bursa.

Larva bluish, not banded; sclerotized plates surrounding body setae small; 2 setae in group VII on abdominal segments 7 and 8.

The larvae are solitary feeders in the trunks of *Cylindropuntia* and *Trichocereus*.

Egg and egg-laying habits unknown.

Remarks.—This genus is close to *Alberada* but distinguished by several characters: The fore wings are distinctly narrower, the vinculum is longer in proportion to its width, the aedeagus more evenly sclerotized, the apical process of gnathos more narrowly cleft, the anellus more decidedly curved, the bursa simple, without signum or scrobinations, the transverse markings on fore wing almost obliterated, and the maxillary palpi much larger. The maxillary palpi are similar to those of *Sigelgaita*, the moths of which resemble in general habitus those of *Nanaia*. The two genera, however, are easily distinguished by their different labial palpi, porrect in *Nanaia*, upturned in the males of *Sigelgaita*.

Known only from Peru.

1. NANAIA SUBSTITUTA, new species

PLATES 25, 42, 47; FIGURES 8–8d, 72–72a, 97–97a

Male.—General color (except hind wings) ocherous-fuscous peppered with black and white; the type darker than most of the paratypes. Fore wing with pale color confined to costal half of wing; terminal area and the area between cell and inner margin darker, with very little white dusting; in most specimens a rather pronounced, broad, longitudinal, ocherous-fuscous shade in the fold; transverse and discal markings almost obsolete; in a few specimens the antemedial line faintly indicated and in the palest of the paratypes the discal black dots distinguishable, also some black scaling along the veins. Hind wing white with a smoky tint toward apex and termen; terminal margin blackish fuscous; cilia smoky white with a dark subbasal line.

Alar expanse, 37–39 mm.

Genitalia (figs. 8–8c) figured from type.

Female.—Colored like the male except that the hind wing is darker, whitish ocherous rather than white.

Alar expanse, 38–40 mm.

Genitalia (figs. 72–72a) with no appreciable scobinations or granulations in bursa; ductus bursae minutely scobinate at genital opening, otherwise smooth.

Type and paratypes.— U. S. N. M. no. 52748. Paratypes also sent to Mr. Dodd.

Type locality.—Cuzco, Peru.

Food plant.—Opuntia (*Cylindropuntia*) *exaltata* Berger.

Remarks.—Described from male type and 5 male and 6 female paratypes, all from the type locality and reared by Dr. J. E. Wille from larvae feeding in the trunks of *Opuntia exaltata* ("Em. XII-6-8-36, 1-5-19, 37," Wille no. 336-36). I also have before me two specimens (male and female) that may be a variety of *substituta* but that are probably a distinct species. They were reared by Dr. Wille from larvae feeding in trunks of *Trichocereus* at Cocachacra, Peru ("Em. XII-12-36 and XII-19-36," Wille no. 333-36). Unfortunately these specimens lack abdomens and are otherwise in such poor condition that it is impossible to determine them any further than to the genus.

6. Genus CACTOBLASTIS Ragonot

Cactoblastis RAGONOT, Mémoires sur les Lépidoptères, vol. 8, p. 15, 1901.—DYAR, Proc. Ent. Soc. Washington, vol. 30, p. 135, 1928. (Genotype: *Zophodia cactorum* Berg.)

Neopyralis BRÈTHES, Chacaras e Quinaes, vol. 20, no. 1, p. 18, 1920. (Genotype: *Neopyralis ronnai* Brèthes.) (New synonymy.)

Antenna of male pubescent, of female shortly pubescent. Labial palpus of male ascending (upcurved), of female porrect. Hind wing with veins 7 and 8 shortly anastomosed beyond cell; 3 and 5 shortly stalked. Eighth abdominal segment of male simple.

Male genitalia with apical process of gnathos partially fused, the prongs separated only for a short distance; harpe with apex evenly rounded; vinculum short; anellus with base of plate narrowly sclerotized, arms moderately long and rather slender, slightly twisted, very finely serrate on outer edges toward apices; aedeagus stout, moderately long.

Female genitalia with signum developed as a series of more or less fused plates; bursa copulatrix weakly and very finely scobinate; ductus seminalis from bursa at junction of ductus bursae and bursa copulatrix.

Larva bright orange or red, with rows of large black spots resembling broken cross bands; two setae in group VII on abdominal segments 7 and 8.

The larvae feed gregariously in the joints of *Platypuntia*, *Cylindropuntia*, *Trichocereus*, *Echinopsis*, and *Denmoza*.

Eggs laid in long chains.

Remarks.—The genus as here defined is distinguished from other cactus-feeding phycitids by the following combination of characters: Antennae of both sexes pubescent; labial palpi upcurved in the male, porrect in the female; veins 7 and 8 of hind wing shortly anastomosed; veins 3 and 5 shortly stalked; apical process of gnathos partially fused; eighth abdominal segment of male simple; larvae bright orange or red, with rows of large black spots resembling broken cross bands, gregarious in habit.

Four (possibly five) species are recognized as belonging to the genus. Its natural distribution is apparently limited to South America, south of the Equator; but at least one of its species (*cactorum*) has been introduced and become established in Australia.

KEY TO THE SPECIES OF CACTOBLASTIS

MALES

1. Hind wings white 2
 Hind wings brown 5. bucyrus Dyar
2. Hind wings semihyaline 3
 Hind wings dull white 4. mundelli, new species
3. Fore wing with a row of 7 distinct black dots along termen. 1. cactorum (Berg)
 Fore wing without such terminal dots or with 3 or 4 very faintly indicated 3. doddi, new species

FEMALES

1. Hind wings semihyaline toward their bases 1. cactorum (Berg)
 Hind wings brownish or fuscous throughout 2
2. Hind wings smoky fuscous 3
 Hind wings brownish fuscous 5. bucyrus Dyar
3. Hind wings pale smoky fuscous 4. mundelli, new species
 Hind wings dark smoky fuscous 3. doddi, new species

1. CACTOBLASTIS CACTORUM (Berg)

PLATES 26, 38, 44, 47; FIGURES 9–9c, 48–48a, 80, 98–98a, 99

Zophodia cactorum BERG, Anal. Soc. Cient. Argentina, vol. 19, p. 276, 1885.
Cactoblastis cactorum (Berg) RAGONOT, Mémoires sur les Lépidoptères, vol. 8, p. 16, 1901.—DODD, Council for Scientific and Industrial Research, Australia, Bull. 34, p. 30, 1927; Bull. Ent. Res., vol. 27, p. 509, 1936.—DYAR, Proc. Ent. Soc. Washington, vol. 30, p. 135, 1928.

Male.—Head sordid whitish ocherous. Palpi pale cinereous, the tips of the maxillary palpi and the ends of the segments of the labial palpi blackish fuscous. Thorax dull ocherous-fuscous rather heavily dusted with blackish fuscous on posterior half. Fore wing ocherous-fuscous more or less dusted with white on costal half between antemedial line and apex; antemedial line black, angulate, the apex of angle at vein 1b, sometimes obscure except on costal half; subterminal line black, with a narrow whitish outer border and beyond this a faint fuscous band, the black line straight from near apex to vein 6, thence sinuate and dentate to inner margin, the ends of the dentations rounded; a black spot at end of cell and a few scattered black scales on disc; along termen at vein ends a row of seven distinct black dots. Hind wing white, semihyaline, costal margin narrowly bordered with fuscous and on termen a fine black line, the latter not extending to inner angle. Mid tibia pale cinereous with a narrow, black, transverse band at outer fourth.

Alar expanse, 23–32 mm.

Genitalia not exhibiting any marked specific characters; the slight comparative differences from the genitalia of the other *Cactoblastis* species are shown in figures 9–9c, 10, 11, and 12–12c.

Female.—Hind wing white, semihyaline with some fuscous shading on the veins and a rather broad fuscous suffusion at apex and along termen for a short distance from apex. Otherwise similar to the male except for the normal sexual differences in antennae and labial palpi.

Alar expanse, 27–40 mm.

Genitalia (figs. 48–48a) not exhibiting any marked specific differences from those of other *Cactoblastis* species except perhaps in the narrower width of the eighth segment collar. This character, however, is individually variable.

Type.—Location unknown.

Type locality.—Argentina.

Food plants.—Opuntia (*Platypuntia*) spp. Apparently limited to the Platypuntias.

Distribution.—ARGENTINA: La Plata, Concordia, Tacanitas, Santiago del Estero. URUGUAY: Piriapolis. AUSTRALIA (introduced and established). According to Dodd "*cactorum* is a native of Uruguay and the northern Argentine provinces of Entre Rios, Corrientes Sante Fe, Santiago del Estero, Tucuman, Salta, and Chaco." He also includes Paraguay and southern Brazil in its possible range; but we have no adult specimens from the latter localities.

Thirty-five specimens examined.

Remarks.—This is the species that has been used with such remarkable success in the biological campaign against the pricklypear in Queensland and New South Wales. In 1925, when some 2,750 eggs of *cactorum* were taken to Australia for rearing and distribution of the moths, about 60,000,000 acres had been overrun by pricklypear. By 1936 "approximately 25,000,000 acres of good grazing and agricultural land, previously a wilderness of dense pricklypear, had been retrieved to such an extent that they are rapidly being developed and brought into production. The remarkable results are due to the activities of one insect, the Argentine moth-borer, *Cactoblastis cactorum* Berg." Dodd's 1936 paper gives a detailed and moving account of the great campaign, probably the most spectacular in the history of economic entomology.

The species seems to be definitely established in Australia.

Descriptions of the larva are given by Berg and Ragonot. They are detailed and accurate but apply to the genus rather than to *cactorum* specifically.

2. CACTOBLASTIS RONNAI (Brèthes), new combination

Neopyralis ronnai BRÈTHES, *in* Ronna, Chacaras e Quinaes, vol. 20, no. 1, p. 18, 1920.—COSTA LIMA, Terceiro catalogo dos insectos que vivem nas plantas do Brazil, p. 268, no. 1031, 1936.

The description of Brèthes's supposed new genus and new species is misleading, and the placement of them in the Schoenobiinae obviously an error. Ronna states that the species was reared from caterpillars feeding in spineless cactus in Rio Grande do Sul. They are described as clear yellowish, with black transverse bands or rows of black spots on each segment. This description can hardly apply to any cactus larva other than *Cactoblastis*. Dodd writes that "Mr. Mundell carried out investigations in Rio Grande do Sul and Santa Catherina in May 1937. The only larva found attacking pricklypears was a *Cactoblastis*, which was generally distributed and often com-

mon. The main host plant was an *Opuntia* closely related to *O. vulgaris* Miller (=*O. monacantha* Haworth), the sole indigenous prickly-pear located in these states; the larvae were encountered in the spineless *O. ficus-indica* in garden plots. Mr. Mundell was unable to rear adults, but considered that the larvae and eggs were not typical *cactorum*. I think there can be little doubt that *Neopyralis ronnai* is the *Cactoblastis* of southern Brazil, which is either *C. cactorum* or an allied form."

Until the Brazilian form can be reared or Brèthes's types examined, *ronnai* must remain as an unrecognized *Cactoblastis*.

Type.—Location unknown.

Type locality.—Rio Grande do Sul, Brazil.

Food plant.—"Spineless cactus."

3. CACTOBLASTIS DODDI, new species

PLATES 26, 38; FIGURES 10, 49–49a

Cactoblastis bucyrus DODD (not Dyar), Council for Scientific and Industrial Research, Australia, Bull. 34, p. 30, 1927.

Male.—Similar to that of *cactorum* except as follows: White dusting on fore wing less contrasted, sparser; general color darker, decidedly grayish fuscous in specimens from Tucuman; dentations of subterminal line of fore wing acute and their ends pointed; black dots along termen very faintly indicated, normally altogether absent.

Alar expanse, 31–38 mm.

Genitalia similar to those of *cactorum*, differing chiefly in the shorter cleft between the prongs at apex of gnathos (fig. 10). This character, however, is subject to some individual variation, and should be used with discretion.

Female.—Similar in color to the male except that the hind wings are smoky fuscous throughout. Similar to the female of *bucyrus* except for the absence of terminal black dots on fore wing.

Alar expanse, 35–41 mm.

Genitalia (figs. 49–49a) with scobinations of bursa somewhat more uniformly distributed than in other species of *Cactoblastis*, not an altogether reliable or satisfactory character in this genus.

Type and paratypes.—U.S.N.M. no. 52749. Paratypes also sent to Mr. Dodd.

Type locality.—Tapia, Tucuman, Argentina.

Food plants.—*Opuntia* (*Platypuntia*) *sulphurea* G. Don, *Opuntia* (*Platypuntia*) *ficus-indica* (Linnaeus).

Remarks.—Described from male type, three male and four female paratypes from the type locality, reared in October 1936 by R. C. Mundell from larvae feeding in *O. sulphurea;* six males and eight

female paratypes from the type locality reared (by Mundell) in October 1936 from larvae in *O. ficus-indica;* six male and three female paratypes from Mendoza, Argentina, reared (by Mundell) in October 1937 from larvae in *O. sulphurea;* and three male and four female paratypes reared in Australia (Dodd no. 49).

Thirty-eight specimens examined.

According to Dodd, this species "is distributed along the eastern edge and foothills of the Andes from Mendoza right to the northern boundary of the Republic in *O. sulphurea,* and almost certainly into southern Bolivia at altitudes to 8,000 feet and probably more. Hence, as far as our information goes, No. 49 (*doddi*) inhabits territory lying in between that of *cactorum* and the Peruvian insect (*mundelli*)."

O. sulphurea seems to be the favored host of *doddi.* Mr. Dodd tells me that *cactorum* does not attack this cactus although it is abundant in territory within the range of that insect. He also states that there are consistent differences in the eggs and egg sticks between the two species and that their larvae can be distinguished in the field. I am unable to separate alcoholic specimens of the larvae with any certainty. The moths can be distinguished easily enough by the characters given in the key.

Named in honor of Alan P. Dodd.

4. CACTOBLASTIS MUNDELLI, new species

PLATES 26, 47; FIGURES 11, 100, 101

Male.—Head ocherous. Palpi cinereous, dusted with black. Thorax ocherous-fuscous, heavily dusted with white and black scales, especially on tegulae and posterior margin. Fore wing ocherous-fuscous with a fine dusting of white scales in costal area from base to apex; some black scaling on the veins; discal dot at end of cell somewhat obscured by a dark smudge which extends beyond the cell toward vein 1b; transverse black lines distinct and well contrasted against the ground color; dentations of subterminal line as in *doddi;* a row of seven small black dots on termen at the vein ends. Hind wing dull white with a faint smoky tint; veins faintly outlined in fuscous-ocherous; some fuscous shading along costa and a fine fuscous line on termen from apex to about vein 1b.

Alar expanse, 38–40 mm.

Genitalia with base of apical process of gnathos (fig. 11) nearly square when viewed from beneath.

Female.—Like the male in color and markings except that the hind wing is pale smoky fuscous.

Alar expanse, 42 mm.

Genitalia not specifically different from those of *cactorum* except for a somewhat shorter ductus bursae.

Type and paratypes.—U.S.N.M. no. 52750. Paratypes also sent to Mr. Dodd.

Type locality.—Arequipa, Peru.

Food plant.—*Opuntia* (*Cylindropuntia*) *exaltata* Berger.

Remarks.—Described from male type and five male and one female paratypes, all from the type locality and reared by R. C. Mundell (Oct.-Nov. 1936).

Apparently this species does not attack the Platypuntias. Mr. Dodd writes that "the Platypuntia, *O. ficus-indica* (which is a host of *cactorum* in Argentina), is grown in cultivations around Arequipa but seems to be immune from attack. Mr. Mundell states that he found larvae in *O. exaltata* growing alongside noninfested plants of *ficus-indica*."

The species is easily recognized by the color of the hind wings and the ocherous suffusion on the fore wings.

Named in honor of R. C. Mundell.

5. CACTOBLASTIS BUCYRUS Dyar

PLATES 26, 38; FIGURES 12–12c, 50–50b

Cactoblastis bucyrus DYAR, Insecutor Inscitiae Menstruus, vol. 10, p. 16, 1922; Proc. Ent. Soc. Washington, vol. 30, p. 135, 1928.

Male.—Much darker than males of other species of *Cactoblastis*. Palpi and thorax heavily dusted with blackish scales. Head and collar ocherous. Fore wing brownish fuscous; white dusting inconspicuous, the pale scales more ocherous than white; black antemedial and subterminal lines somewhat obscured by the dark ground color, conspicuous only toward costa, dentations of subterminal line as in *doddi;* a row of seven black dots along termen at vein ends. Hind wing brownish fuscous.

Alar expanse, 30–32 mm.

Genitalia (figs. 12–12c) with arms of anellus somewhat shorter than those of *cactorum*, *doddi*, and *mundelli*.

Female.—In color and markings similar to the male, pale dusting on fore wing a trifle more noticeable, more whitish than ocherous.

Alar expanse, 40–41 mm.

Genitalia (figs. 50–50b) with bursa very minutely and sparsely scobinate. The signum, like that of other species of *Cactoblastis*, is individually variable. Extremes of variation are shown in figures 50 and 50b.

Type.—In United States National Museum.

Type locality.—Mendoza, Argentina.

Food plants.—*Trichocereus*, *Echinopsis*, *Denmoza*.

Distribution.—ARGENTINA: Tucuman, Tapia, Mendoza, Catamarca, Andalgala.

Twelve specimens examined.

Remarks.—Concerning hosts, Mr. Dodd supplies the following note: "The food plants of *Cactoblastis bucyrus* in Tucuman are *Trichocereus terscheckii* (Parmentier) and *Echinopsis shaferi* Britton and Rose; *Stetsonia* is not a known host plant. Dyar described this insect from material reared by W. B. Alexander from *Echinocactus* (?) at Mendoza and from *Echinopsis* at Andalgala. The '*Echinocactus*' from Mendoza is undoubtedly *Denmoza rhodacantha* (Salm-Dyck). The *Echinopsis* from Andalgala is probably *E. tubiflora* (Pfeiffer)."

7. CAHELA, new genus

Genotype.—*Olyca ponderosella* Barnes and McDunnough.

Antennae of male and female pubescent, the pubescence shorter in the female. Labial palpus of male obliquely upturned, of female porrect, with third segment downcurved and second and third segments longer than those of male; male palpus not extending above middle of front and with third segment short. Maxillary palpus squamous. Hind wing with veins 7 and 8 shortly anastomosing beyond cell; 3 and 5 stalked. Eighth abdominal segment of male simple.

Male genitalia with apical process of gnathos fused; harpe with apex evenly rounded; vinculum short; anellus with base of plate narrowly sclerotized, arms long and broad, slightly twisted; aedeagus stout, sclerotized throughout.

Female genitalia with signum developed as a ridged plate (a hollow, blunt, flattened, more or less thornlike projection into the bursa); bursa copulatrix large, finely scobinate especially in the neighborhood of the signum; ductus bursae scobinate at genital opening; ductus seminalis from bursa near signum.

Larvae whitish, not banded or conspicuously spotted; solitary in habit; stem borers in Cylindropuntias.

Eggs laid singly.

Remarks.—This genus and the following (*Rumatha*) are distinguished from all others in the cactus-feeding group by the complete fusion of the apical process of the gnathos. Several male characters distinguish the two genera from each other, but *Cahela* is most easily recognized by the black longitudinal lines between the veins on the fore wing.

The genus is apparently limited in distribution to the southwestern part of the United States and northern Mexico.

1. CAHELA PONDEROSELLA (Barnes and McDunnough)

PLATES 26, 38, 47; FIGURES 13–13f, 51–51a, 102–102a, 103–103a

Olyca ponderosella BARNES and MCDUNNOUGH, Contr. Nat. Hist. Lepid. North America, vol. 4, no. 2, p. 175, 1918.

Zophodia purgatoria DYAR, Insecutor Inscitiae Menstruus, vol. 13, p. 222, 1925. (New synonymy.)

Cactobrosis interstitialis DYAR, Insecutor Inscitiae Menstruus, vol. 13, p. 223, 1925; Proc. Ent. Soc. Washington, vol. 30, p. 136, 1928. (New synonymy.)

Cactobrosis phoenicis DYAR, Insecutor Inscitiae Menstruus, vol. 13, p. 223, 1925; Proc. Ent. Soc. Washington, vol. 30, p. 136, 1928. (New synonymy.)

Cactobrosis (?) *ponderosella* (Barnes and McDunnough) DYAR, Proc. Ent. Soc. Washington, vol. 30, p. 136, 1928.

Male.—Head, thorax, fore wings, and body dark fuscous-gray peppered with white and with pronounced, longitudinal, black lines on the fore wing; a long black line through the cell and extending from near base of wing to termen; another long black line from base to tornus running parallel and very close to the fold; in outer area, from beyond cell to apex and termen, five other shorter black lines, the longest and most pronounced above vein 6; all the black lines between and not on the veins; antemedial and subterminal lines normally obsolete; in a very few specimens a faint indication of a partial, black, antemedial line and in several specimens a dark shade from end of cell to middle of inner margin, but no trace of any transverse subterminal line; body somewhat paler than fore wing or thorax. Hind wing white, semihyaline, termen for a short distance from costa very faintly and narrowly edged with fuscous.

Alar expanse, 30–40 mm.

Genitalia (figs. 13–13f) figured from type. There is some variation in the shape and size of the terminal process of the gnathos in different specimens from any given locality. The extremes of variation are shown in figures 13–13c.

Female.—Similar to the male in color and markings except for a more pronounced fuscous shading along termen of hind wing.

Alar expanse, 26–42 mm.

Genitalia (figs. 51–51a) figured from paratype from the type locality. The size of the signum and bursa varies somewhat in different specimens, but the variations are slight and can be found in any series from one locality.

Types.—In United States National Museum (*ponderosella, purgatoria, interstitialis, phoenicis*).

Type localities.—Palm Springs, Calif. (*ponderosella, phoenicis*); Colorado Desert, Yuma County, Ariz. (*purgatoria*); Presidio, Tex. (*interstitialis*).

Food plant.—*Opuntia* (*Cylindropuntia*) *imbricata* (Haworth) and probably other Cylindropuntias.

Distribution.—UNITED STATES: *California*, Palm Springs (Apr., Aug.), San Bernardino (Apr., May); *Utah*, St. George (May, June); *Nevada*, Charlestown Mountains (July), Clark County (Apr., May, June); *Arizona*, Yuma County, Mohave County (Apr., May), Dewey (June), "en route from Dewey to Salome" (Apr.), Maricopa County (July), Prescott (Apr., June), Redington, Baboquivari Mountains (Pima County, May, July, Aug.), Phoenix (May), Tucson (June), Douglas (May), Christmas (Gila County), Paradise (Cochise County, June); *Texas*, Brewster County, Alpine (Apr.), Presidio.

One hundred and thirty-two specimens examined.

Dodd states that the range of the species includes the central plateau of Mexico, which is what we should expect. I have seen no Mexican specimens.

Remarks.—The species is remarkably uniform in color and markings but varies considerably in size, which accounts for some of the synonymy. Dyar described his *purgatoria* from an exceptionally small female (26 mm). There is a male in the National collection (from Phoenix, Ariz.) only 23 mm in expanse, but this is obviously an abnormal specimen. Its genitalia are correspondingly smaller than those of normal males. The usual expanse of both males and females is about 35 mm. When Dyar described his three species he had not seen the types of *ponderosella* and had very few specimens from any locality.

Superficially *ponderosella* is similar to both *Eremberga leuconips* (Dyar) and *Cactobrosis strigalis* (Barnes and McDunnough). They also are dark gray with conspicuous black longitudinal lines on their fore wings, but in *leuconips* and *strigalis* the black lines are on the veins, while in *ponderosella* they lie between the veins. This character at once distinguishes it from other known cactus phycitids.

8. RUMATHA, new genus

Genotype.—*Zophodia bihinda* Dyar.

Antenna of male shortly serrate and pubescent, of the female simple and pubescent, the pubescence shorter in the female than in the male. Labial palpi porrect in both sexes; third segment of palpus about half as long as second. Maxillary palpus squamous. Hind wing with veins 7 and 8 anastomosing beyond cell; 3 and 5 stalked. Eighth abdominal segment of male simple.

Male genitalia with apical process of gnathos fused; harpe with apex evenly rounded and with a subbasal sclerotized pocket (*pkt*,

fig. 14) between sacculus and costa; uncus truncate and short in proportion to its breadth; vinculum short, truncate, almost square in outline; anellus with base rather broadly sclerotized, arms short, broad, slightly twisted; aedeagus very short, stout, partially sclerotized (on ventral half only). The entire genitalia have a squat appearance that is characteristic.

Female genitalia with signum developed as a ridged plate with inwardly projecting ridge bluntly serrate (except in *glaucatella*, in which the signum is as in *Cahela ponderosella*); bursa copulatrix large, finely scobinate, especially in neighborhood of signum; ductus bursae scobinate at genital opening and with a pair of more or less defined sclerotized plates on the dorsal membrane of the ductus at the opening; ductus seminalis from bursa near signum (but somewhat farther removed than in *Cahela*).

Larva of only one species (*glaucatella*) known; whitish, not banded or conspicuously spotted; solitary in habit; stem borer in *Cylindropuntia*.

Eggs laid singly.

Remarks.—This genus is very close to *Cahela*, and for some time I hesitated about erecting it, for both genera have similar larvae and host associations and a like structure of the gnathos; but there are too many other differences in male characters and adult habitus to permit their lumping. The partially sclerotized aedeagus, the short stout arms of the anellus, the squat appearance of the whole male genitalia, the porrect male labial palpi, and the serrate male antennae at once distinguish the males of *Rumatha* from those of *Cahela;* and the wing patterns readily separate both sexes. In *Rumatha* the discal dot is prominent and the transverse lines on the fore wing are well defined for at least half their length. In *Cahela* the distinctive wing markings are longitudinal.

Three species are recognized as belonging to the genus. Its distribution is limited apparently to the southwestern part of the United States and possibly the adjacent regions of northern Mexico, although as yet no specimens have been received from Mexico.

KEY TO THE SPECIES OF RUMATHA

1. Ground color of fore wing white; expanse 20 mm or less.
1. **glaucatella (Hulst)**

Ground color of fore wing fuscous; expanse 23 mm and over---------- 2

2. Indentation of subterminal line of fore wing between veins 5 and 6 deep, extending to cell; no pinkish scaling on costal area of fore wing---------- 2. **bihinda (Dyar)**

Indentation of subterminal line of fore wing between veins 5 and 6 shallow, not extending to cell; a scattering of pinkish scales among white scales on costal area of fore wing------ 3. **polingella (Dyar)**

1. RUMATHA GLAUCATELLA (Hulst)

PLATES 27, 39, 48; FIGURES 16–16c, 52, 104–104a, 105–105a

Honora glaucatella HULST, Entomologica Americana, vol. 4, p. 117, 1888.
Zophodia glaucatella (HULST), Trans. Amer. Ent. Soc., vol. 17, p. 174, 1890; U. S. Nat. Mus. Bull. 52, p. 430, 1903.—RAGONOT, Mémoires sur les Lépidoptères, vol. 8, p. 23, 1901.—BARNES and MCDUNNOUGH, Check list of the Lepidoptera of Boreal America, no. 5712, 1917.

Male.—Palpi, head, and thorax pale fuscous, sparsely sprinkled with white; posterior margin of thorax edged with blackish fuscous. Fore wing dull white, sparsely sprinkled with fuscous and with a very pale fuscous stain in a broad area bordering inner margin; antemedial line angulate, fuscous, rather faint but complete and always distinguishable; subterminal line double, consisting of two parallel, faint, pale-fuscous lines, almost vertical and but very slightly dentate; discal spot at end of cell blackish fuscous, prominent; a row of small blackish dots along termen between the vein ends. Hind wing whitish with a very pale fuscous line edging termen.

Alar expanse, 15–18 mm.

Genitalia (figs. 16–16c) much smaller than those of either *bihinda* or *polingella;* basal portion of aedeagus narrower in proportion; harpe with apex more bluntly rounded than that of *polingella* but with width of harpe less in proportion to its length than that of *bihinda.*

Female.—In color, markings, and palpal structures similar to the male. Pubescence of antenna much shorter.

Alar expanse, 16–20 mm.

Genitalia (fig. 52) with signum similar to that of *Cahela ponderosella*, the inwardly projecting edge not appreciably serrate; sclerotized plates in genital opening very weak, hardly distinguishable except under very high magnification.

Larvae.—Solitary in habit, white, not banded or conspicuously spotted.

Type.—In Rutgers College collection.

Type locality.—Texas.

Food plant.—Opuntia (*Cylindropuntia*) *leptocaulis* De Candolle.

Distribution.—UNITED STATES: *Texas*, San Benito (May, June, July, Aug.), Brownsville (June), San Diego (May), Laredo (July), San Antonio; *Florida* (one female, so labeled and without other locality, from the Fernald collection in the United States National Museum).

Seventeen specimens examined.

Remarks.—The labial palpus of the male is somewhat misleading. In natural position the third segment is projected forward as in fig. 104; but in relaxed and badly prepared specimens it may be bent

upward. The pattern markings (particularly the pronounced discal spot) and the male genitalia show that *glaucatella* belongs with *bihinda* and *polingella* rather than in *Cahela*.

2. RUMATHA BIHINDA (Dyar)

PLATES 27, 39, 48; FIGURES 14–14c, 54, 108–108a, 109–109a

Zophodia bihinda DYAR, Insecutor Inscitiae Menstruus, vol. 10, p. 173, 1922.
Rumyela bihinda (DYAR), Insecutor Inscitiae Menstruus, vol. 13, p. 221, 1925.

Male.—Palpi, head, thorax, fore wings, and abdomen dark fuscous, dusted with white, giving a decidedly grayish-fuscous appearance to the moth; the white dusting heavy on costal half of fore wing and upper surface of abdomen; discal spots and transverse markings on fore wings blackish fuscous. Fore wing with area between cell and inner margin brownish, with little or no white dusting and with transverse lines obscured; costal half (especially above cell) strongly suffused with white; transverse antemedial line blackish, distinct only from costa to fold; subterminal line markedly dentate and sinuate, blackish, oblique, broad and conspicuous from costa to vein 8, with a slight dentation between veins 8 and 6 and a deep angulation between veins 5 and 6 extending to cell, between vein 5 and the fold straight and inwardly slanting, thence obscure to inner margin of fore wing; discal dots at end of cell normally conspicuous and fused into a single black spot, obscure in a few specimens; a row of black dots along termen at the vein ends; in some specimens faint traces of a black longitudinal line through center of cell and a line of blackish scales along the fold. Hind wing white, semihyaline, with a fine, faint, fuscous line along termen and some fuscous shading on costal margin. Under surface of abdomen decidedly brownish fuscous, sparsely dusted with white. Legs with femora whitish, with some fuscous spotting; coxae uniformly dark brown, with no white dustings or markings, strongly contrasted against femora.

Alar expanse, 30–35 mm.

Genitalia (figs. 14–14c) appreciably larger than those of other species in the genus; harpe broader in proportion to its length and with apex more broadly rounded.

Female.—Similar to the male in color and markings. Labial palpus somewhat longer and pubescence of antenna appreciably shorter.

Alar expanse, 32–36 mm.

Genitalia (fig. 54) similar to those of *polingella* and hardly to be distinguished; signum with inner projecting edge irregularly and bluntly serrate.

Type.—In United States National Museum.

Type locality.—Jemez Springs, N. Mex.

Food plant.—Unknown.

Distribution.—UNITED STATES: *Texas*, Alpine (Apr.); *New Mexico*, Jemez Springs (June, July); *Arizona*, Yuma County (Apr.), "en route from Dewey to Salome" (Apr.), Dewey (May), Mohave County (March); *Nevada*, Clark County (March, Apr., May), Bellevue (Washington County, May).

Thirty-eight specimens examined.

Remarks.—This species has never been reared and its larva is unknown. From its close relationship to *glaucatella* we may expect that its host will prove to be one of the Cylindropuntias.

3. RUMATHA POLINGELLA (Dyar)

PLATES 27, 39, 48; FIGURES 15–15c, 53, 106–106a, 107–107a

Zophodia polingella DYAR, Journ. New York Ent. Soc., vol. 14, p. 31, 1906.—BARNES and MCDUNNOUGH, Check list of the Lepidoptera of Boreal America, no. 5713, 1917.

Male.—Similar in appearance to that of *bihinda* but with transverse antemedial and subterminal lines more distinctly continued to inner margin of fore wing; indentations of subterminal line not so deep as in *bihinda* and not extending to cell; a scattering of pinkish scales among the white scales on costal area of fore wing.

Alar expanse, 23–34 mm.

Genitalia (figs. 15–15c) similar to those of *bihinda* but with harpe narrower, apex of harpe more acutely rounded, and aedeagus slightly narrower in proportion to its length.

Female.—Similar to the male except for shorter pubescence on antenna.

Alar expanse, 26–35 mm.

Genitalia (fig. 53) essentially like those of *bihinda* except that the sclerotized plates in genital opening are not so distinct and the signum is on the average smaller.

Type.—In United States National Museum.

Type locality.—Southern Arizona.

Food plant.—Unknown, presumably a *Cylindropuntia*.

Distribution.—UNITED STATES: *Arizona*, Douglas (June, Aug.), Redington, Palmerlee, Paradise (Cochise County, July, Sept.), Pinal Mountains (Apr.), Baboquivari Mountains (June, July, Aug., Sept.), Santa Catalina Mountains (Aug.), "southern Arizona" (Apr.).

Seventy-one specimens examined.

Remarks.—This species also has not been reared, and its life history is unknown. It is obviously distinct from *bihinda* but evidently very close to that species and is quite similar to it in general appearance. The characters given in the key will separate it readily enough.

9. Genus YOSEMITIA Ragonot

Yosemitia RAGONOT, Mémoires sur les Lépidoptères, vol. 8, p. 17, 1901. (Genotype: *Spermatopthora graciella* Hulst.)

Yosemetia HULST, U. S. Nat. Mus. Bull. 52, p. 429, 1903.—DYAR, Insecutor Insectiae Menstruus, vol. 13, p. 220, 1925. (Misspelling for *Yosemitia*.)

Antenna of male weakly serrate and pubescent, of female simple and shortly pubescent. Labial palpi obliquely porrect. Maxillary palpus fan-shaped and held vertically to the face. Hind wing with veins 7 and 8 anastomosing beyond cell; veins 3 and 5 stalked. Eighth abdominal segment of male simple.

Male genitalia with apical process of gnathos bifid; harpe with apex evenly rounded; vinculum moderately long; anellus with arms broad, short, slightly twisted, and base of plate broadly sclerotized; aedeagus short and slender, sclerotized throughout.

Female genitalia with signum developed as a small, shortly spined plate; ductus bursae short; bursa copulatrix finely scobinate, especially in area about signum; ductus seminalis from bursa near junction of bursa and ductus bursae.

Larva bluish, dark, not banded or conspicuously spotted.

The larvae feed gregariously (sometimes singly) in *Echinocereus*, *Coryphantha*, *Homalocephala*, and presumably also in *Echinocactus* and *Neomamillaria*.

Eggs laid singly.

Remarks.—This genus as here defined is distinguished by the following combination of characters: Male antenna serrate and pubescent; labial palpi porrect in both sexes; maxillary palpi fan-shaped; male genitalia with vinculum moderately long and rather narrow, apical process of gnathos bifid, anellus small and stout with broad short arms, aedeagus slender; eighth abdominal segment of male simple; female genitalia with signum a small, shortly spined plate, ductus bursae short and ductus seminalis from bursa copulatrix near junction of bursa and ductus bursae; larvae not banded and normally gregarious.

The male genitalia have a characteristic habitus which makes them easy to place generically; but the differences between species are very slight and not altogether trustworthy, hardly more than might be expected within specific limits.

Four species are recognized as belonging to the genus. Its distribution is the southwestern part of the United States and Mexico.

KEY TO THE SPECIES OF YOSEMITIA

1. A short blackish line on midcosta of fore wing 4. **didactica** Dyar
 No such line on midcosta of fore wing 2
2. Subterminal line of fore wing interrupted between veins 6 and 5.
 1. **graciella** (Hulst)

Subterminal line not interrupted between veins 6 and 5 3

3. A blackish curved line from antemedial line through cell to upper outer angle of cell 3. **fieldiella** (Dyar)

No such blackish line connecting antemedial line and outer angle of cell 2. **longipennella** (Hulst)

1. YOSEMITIA GRACIELLA (Hulst)

Plates 28, 40, 44, 48; Figures 21–21d, 57, 79, 111–111a

Spermatopthora graciella Hulst, Entomologica Americana, vol. 3, p. 134, 1887.
Zophodia graciella (Hulst), Trans. Amer. Ent. Soc., vol. 17, 173, 1890.
Yosemitia graciella (Hulst) Ragonot, Mémoires sur les Lépidoptères, vol. 8, p. 13, 1901.—Barnes and McDunnough, Contr. Nat. Hist. Lepid. North America, vol. 3, no. 3, p. 199, 1916; Check list of the Lepidoptera of Boreal America, no. 5699, 1917.
Yosemetia graciella (Hulst), U. S. Nat. Mus. Bull. 52, p. 429, 1903.—Dyar, Insecutor Inscitiae Menstruus, vol. 13, p. 220, 1925.

Male.—Palpi, face, head, and thorax pale brownish fuscous, the palpi sparsely dusted with white, the tegulae with posterior ends shaded with black. Fore wing pale brownish fuscous dusted and streaked with black and dusted with white scales; the white scaling concentrated on and strongly whitening the costal half of the wing; the black scaling thinly dusted over the lower half of the wing (between cell and inner margin) and outlining the veins; transverse lines incomplete, blackish; the antemedial line indicated only by a transverse dash in the cell and a dot or very short streak on inner margin; subterminal line prominent from costa near apex to vein 8 (sometimes to vein 6), inwardly slanting, *interrupted between veins* 6 and 5, obscure between vein 2 and inner margin; discal dots fused into a line of black scales on discocellular vein; a row of small black dots along termen between the vein ends. Hind wing whitish, shaded with very pale fuscous at apex, along costa, and narrowly along termen; cilia white with a very fine, pale fuscous, subbasal line.

Alar expanse, 25–30 mm.

Genitalia (figs. 21–21c) very little different from those of other species in the genus; the vinculum is not so broad as that of *fieldiella* or so long as that of *didactica;* the anelli of the several species (figs. 18b, 19b, 20b, 21b) seem to offer the best characters for separating the species on genitalic characters; those of *graciella* and *longipennella* are much alike, but in *didactica* the arms appear to be more sharply twisted and in *fieldiella* the basal portion is more narrowly sclerotized and the free arms, therefore, correspondingly longer. These characters, however, may not be constant in long series.

Female.—Superficially like the male except that the labial palpus is appreciably longer, the antennal pubescence shorter, and the hind wings very pale, smoky fuscous rather than white.

Alar expanse, 25–30 mm.

Genitalia (fig. 57) with signum a trifle smaller than that of any other *Yosemitia*, otherwise not specifically distinguished.

Larvae "dark, dull blue, and solitary or gregarious in habit" (Dodd).

Type.—In Rutgers College collection.

Type locality.—Blanco County, Tex.

Food plants.—*Echinocereus viridiflorus* Engelmann, *E. polyacanthus* Engelmann, and *Coryphantha aggregata* (Engelmann).

Distribution.—UNITED STATES: *Colorado*, Denver (July) and one specimen with only the State designation; *Nevada*, Clark County (Apr., May); *California*, San Bernardino County (Apr.), Providence Mountains (May), one specimen with only State designation (Apr.); *Arizona*, Yavapai County, Ajo (Pima County, March), Baboquivari Mountains (May), White Mountains (June), Pinal Mountains (Apr.), Quijotoa Mountains (June), Santa Rita Mountains (June), Sells P. O. (Pima County, May), "en route from Dewey to Salome" (Apr.), Mojave County (May), Roosevelt (June), Phoenix (March, Apr.), Redington, no locality except the state (2 specimens reared from *Coryphantha aggregata*, June); *New Mexico* (March); *Texas* (no specific locality, one specimen reared from *Echinocereus viridiflorus*, Apr.).

Seventy-six specimens examined.

Remarks.—This species bears a superficial resemblance to *Rumatha bihinda* (Dyar) and might easily be confused with that species. On other than structural characters it is most readily distinguished by the distinct black scaling outlining the veins and rather strongly contrasted against the white dusting on the costal half of the fore wing.

I follow Barnes and McDunnough (1916) and Hulst (1890) in reference to the type locality. According to the former the type is from Texas and not Colorado as given by Hulst in 1888.

2. YOSEMITIA LONGIPENNELLA (Hulst)

PLATES 28, 40, 48; FIGURES 20–20c, 58, 112–112a, 113–113a

Zophodia longipennella HULST, Entomologica Americana, vol. 4, p. 118, 1888.
Zophodia graciella (HULST, in part), Trans. Amer. Ent. Soc., vol. 17, p. 173, 1890.
Yosemitia graciella (Hulst, in part) RAGONOT, Mémoires sur les Lépidoptères, vol. 8, p. 13, 1901.
Yosemetia graciella longipennella (HULST), U. S. Nat. Mus. Bull. 52, p. 429, 1903.
Yosemitia graciella longipennella (Hulst) BARNES and MCDUNNOUGH, Check list of the Lepidoptera of Boreal America, no. 5699, 1917.
Yosemetia longipennella (Hulst) DYAR, Insecutor Inscitiae Menstruus, vol. 13, p. 220, 1925.

Male.—Similar to that of *graciella* except black dusting on fore wing sparse, veins not or but very faintly outlined by black scales,

transverse subterminal line *not interrupted between veins 6 and 5*, dentate.

Alar expanse, 21–25 mm.

Genitalia (figs. 20–20c) essentially like those of *graciella*.

Female.—Similar to the male in color and markings except that the hind wings have a very pale smoky tint, paler on the average than the hind wings of females of *graciella*.

Alar expanse, 22–26 mm.

Genitalia (fig. 58) similar to those of *graciella* but with signum a trifle larger.

Larvae "dark dull blue, gregarious in habit" (Dodd).

Type.—In Rutgers College collection.

Type locality.—Texas.

Food plant.—*Homalocephala texensis* (Hopffer).

According to Dodd the larvae also feed in *Neomamillaria*.

Distribution.—UNITED STATES: *Texas*, Uvalde (June), "Big Bend" (Apr.), San Antonio (June), Van Horn (June), San Diego (Apr.), San Benito (Apr., May).

Fifteen specimens examined.

Remarks.—When Hulst (1890) transferred his *graciella* from *Spermatopthora* to *Zophodia*, he sank *longipennella* as a synonym of *graciella*. Ragonot also treated them as one species. Dyar, in his catalog (1903), listed *longipennella* as a race or subspecies. Later (1925) he restored it to full specific rank. He was apparently justified in so doing, for, while the two species are close and the differences between them slight, these differences are constant. The host association, the smaller average size, and the shallow indentation of the subterminal line of the fore wing between veins 6 and 5 suggest that *longipennella* is a distinct species rather than a race or variety of *graciella*.

3. YOSEMITIA FIELDIELLA (Dyar)

PLATES 28, 49; FIGURES 18–18c, 114–114a, 115–115a

Zophodia fieldiella DYAR, Insecutor Inscitiae Menstruus, vol. 1, p. 35, 1913.—BARNES and MCDUNNOUGH, Check list of the Lepidoptera of Boreal America, no. 5711, 1917.

Male.—Palpi pale brownish fuscous more or less dusted with white and with some black scaling on ends of maxillary palpi. Head and thorax paler brown, almost clay colored; tegulae tipped with blackish scales. Fore wing heavily dusted with white on costal half and with some scattered white scales on remainder of wing; area between inner margin and cell pale brownish, concolorous with thorax; antemedial line incomplete, distinct only from costa to lower vein of cell; subterminal line complete but obscure except for the blackish costal dash, dentate, the incurvation between veins 6 and 5 shallow; from

antemedial line, where it meets the cell, a *thin, obscure, curved, blackish line extends to upper outer angle of cell;* discal dot small, obscure; on some specimens a few black scales outlining vein 6; on termen a row of obscure blackish dots lying between the vein ends. Hind wing white, with a very pale fuscous line along termen.

Alar expanse, 22 mm.

Genitalia (figs. 18–18c) with basal portion of anellus more narrowly sclerotized and arms correspondingly longer than in the other species of the genus; vinculum also broader and shorter.

Female.—Similar to the male in color and pattern except that the hind wings are very faintly tinted with smoky fuscous.

Alar expanse, 21–25 mm.

Genitalia similar to those of *longipennella*, but signum somewhat larger.

Type.—In United States National Museum.

Type locality.—La Puerta Valley, Calif.

Food plant.—Unknown.

Distribution.—UNITED STATES: *California*, La Puerta Valley (July); *Arizona*, Catalina Springs (May).

Remarks.—The only specimens I have seen are those of the type series in the National collection (one male and five females). The species has not been reared and its larva is unknown. It is easily distinguished from the other North American species of *Yosemitia* by its paler color and the fine, curved, blackish line on the fore wing from the apex of the antemedial line to the outer end of the cell.

4. YOSEMITIA DIDACTICA Dyar

PLATES 28, 48; FIGURES 19–19c, 110–110a

Yosemitia didactica DYAR, Proc. U. S. Nat. Mus., vol. 47, p. 408, 1915.

Male.—Palpi pale brownish fuscous sparsely dusted with white. Head and thorax paler fuscous; tegulae shaded with blackish-fuscous scales at their apices. Fore wing heavily dusted with white on costal half; *a short blackish line on midcosta;* lower half of wing concolorous with thorax; antemedial line obscure, incomplete; discal dot at outer end of cell distinct, blackish; subterminal line complete, dentate, double for a short distance from apex and thence outwardly margined by a narrow pale shade, obscure toward inner margin, parallel to termen; veins 5 to 9 very faintly outlined by dark scaling; terminal row of dots almost obsolete. Hind wing whitish, faintly smoke-tinted, somewhat darker toward apex and along termen; cilia with a pale smoky subbasal line.

Alar expanse, 22 mm.

Genitalia (figs. 19–19c) with vinculum rather longer than that of any other species in the genus; anellus with arms bent about aedeagus.

Female.—Similar to the male in color and markings except that the hind wings are a trifle darker.

Alar expanse, 22–23 mm.

Genitalia similar to those of *graciella.*

Type.—In United States National Museum.

Type locality.—Tehuacan, Mexico.

Food plant.—Unknown.

Distribution.—Mexico: Tehuacan (May, June), Orizaba.

Three specimens (one male and two females) examined.

Remarks.—This species resembles *graciella* but is somewhat paler and the male has slightly darker (smoky) hind wings. It is at once distinguished by the dark line on the midcosta of the fore wing. Its life history is unknown.

10. Genus TUCUMANIA Dyar

Tucumania Dyar, Insecutor Inscitiae Menstruus, vol. 13, p. 224, 1925. (Genotype: *Tucumania tapiacola* Dyar.)

Antenna of male shortly serrate and pubescent, of female simple and shortly pubescent. Labial palpus of male upturned, reaching almost to level of top of eye; of female porrect (the second segment oblique, the third slightly downcurved). Maxillary palpus squamous. Hind wing with veins 7 and 8 anastomosing for a short distance beyond cell; 3 and 5 stalked. Eighth abdominal segment of male simple.

Male genitalia with apical process of gnathos bifid; harpe with apex bluntly pointed or elliptically rounded; vinculum moderately long (it is somewhat foreshortened in fig. 17), broad; anellus with base of plate moderately sclerotized, arms rather broad and long, slightly twisted; aedeagus long, slender; penis weakly scobinate toward outer extremity.

Female genitalia with signum a small ridged or granulate plate; bursa copulatrix with some fine scobinations in the area about signum; ductus seminalis from bursa near junction of bursa and ductus bursae.

Larva purplish or wine colored with sclerotized areas about body tubercles dark brown and large; two setae in group VII on abdominal segments 7 and 8.

The larvae are solitary feeders in the joints of Platypuntias.

Eggs laid singly.

Remarks.—This genus is distinguished from others having serrate and pubescent male antennae and squamous maxillary palpi by its host association, its upturned male palpi, slender aedeagus, female

genitalia with signum and with ductus seminalis from the bursa. It is nearest to *Eremberga*, but that genus is broad-winged and has a flat, more strongly sclerotized anellus, a scobinate aedeagus, stouter male genitalia, no signum, and the ductus seminalis coming from the ductus bursae. In *Tucumania* the wings are long and rather narrow.

The known distribution is Argentina and Uruguay.

KEY TO THE SPECIES OF TUCUMANIA

1. General color of fore wings dark grayish fuscous; expanse 30 mm or less 1. tapiacola Dyar
 General color of fore wings pale purplish fuscous; expanse over 30 mm 2. porrecta Dyar

1. TUCUMANIA TAPIACOLA Dyar

PLATES 27, 40, 44, 49; FIGURES 17–17d, 59–59a, 82, 121–121a, 122

Tucumania tapiacola DYAR, Insecutor Inscitiae Menstruus, vol. 13, p. 225, 1925.

Male.—Palpi, face, head, thorax, and fore wings dark grayish fuscous with a sparse scattering of obscure whitish scales (Dyar states that the coxae and parts of the femora and tibiae of the legs are black, but even on these parts there is some scattered pale scaling and the ground color is fuscous rather than black). Fore wing almost uniformly dark, sometimes a very faint luteous tint in the median area and a slight pale suffusion in terminal area; transverse lines black but not strongly contrasted against the dark ground color; antemedial line bidentate, its apex extending almost to center of cell; subterminal line dentate, sinuate, the dentations short, bordered outwardly by a pale line and beyond this by a rather broad blackish band, from costa well before apex; apical spot at end of cell large; veins beyond cell faintly outlined by dark scaling; a row of black dots along termen at the vein ends. Hind wing whitish, semihyaline, strongly shaded with fuscous at apex and narrowly along margin of termen almost to anal angle.

Alar expanse, 27–28 mm.

Genitalia (figs. 17–17c) with apex of harpe bluntly pointed; anellus with the apices of the arms appreciably broadened. These are presumably specific characters. I have seen no males of any other species of *Tucumania*.

Female.—In color and markings like the male except that the fuscous shading on the hind wing is a trifle more extended.

Alar expanse, 30 mm.

Genitalia (figs. 59–59a) with scobinations of bursa very weak and distinguishable only in area surrounding signum; signum somewhat granulate.

Type.—In United States National Museum.

Type locality.—Tapia, Tucuman, Argentina.

Food plants.—*Opuntia* (*Platypuntia*) *discolor* Britton and Rose, *O.* (*Platypuntia*) *aurantiaca* Lindley.

Distribution.—ARGENTINA.

Remarks.—Only three specimens are before me, the male type and a pair (male and female) reared in Australia from Argentine stock and sent me by Mr. Dodd.

2. TUCUMANIA PORRECTA Dyar

PLATES 40, 49; FIGURES 60, 123

Tucumania porrecta DYAR, Insecutor Inscitiae Menstruus, vol. 13, p. 225, 1925.

Male.—Unknown.

Female.—Larger and paler than that of *tapiacola.* Thorax pale fawn color. Fore wing pale purplish fuscous with black markings diffused; antemedial and subterminal lines narrow, black, irregularly dentate, distinguishable throughout but somewhat interrupted; discal dots at end of cell rather large but not sharply contrasted against ground color of the wing because of scattered black dusting in the surrounding area; dots along termen distinct; a short black streak from base through middle of cell to apex of angulate antemedial line. Hind wing white, faintly smoke-tinted, especially toward apex. Legs pale purplish fuscous; femora and tibiae transversely banded with blackish fuscous on outer sides.

Alar expanse, 32–35 mm.

Genitalia (fig. 60) with scobinations of bursa very fine but denser than in *tapiacola;* a small patch of somewhat larger scobinations in neck of bursa; signum larger, with a thin even keel but no granulations.

Type.—In United States National Museum.

Type locality.—Paysandu, Uruguay.

Food plant.—*Opuntia* (*Platypuntia*) sp.

Distribution.—URUGUAY.

Remarks.—Represented in the National collection only by the type and paratype from the type locality (A. P. Dodd, Feb. 1925), both females.

11. EREMBERGA, new genus

Genotype.—*Cactobrosis leuconips* Dyar.

Antenna of male serrate and pubescent, of female simple and shortly pubescent. Labial palpus of male upturned, of female obliquely porrect. Maxillary palpus squamous. Hind wing with veins 7 and 8 very shortly anastomosed beyond cell; 3 and 5 stalked. Eighth abdominal segment of male simple.

Male genitalia with apical process of gnathos bifid; harpe with apex evenly rounded; vinculum broad and short; anellus with base of plate broadly and strongly sclerotized, arms short, broad, not twisted or bent and with apices pointed; aedeagus moderately long, rather slender, sclerotized throughout and with a minutely scobinate flange at apex.

Female genitalia without signum; bursa copulatrix smooth or with a few scattered microscopic scobinations; ductus bursae short, scobinate at genital opening; ductus seminalis from ductus bursae.

Larva white with dark spots forming incomplete cross bands; two setae in group VII on abdominal segments 7 and 8.

The larvae are solitary or semigregarious feeders in *Echinocereus*. The larva of only one species (*leuconips*) is known but the characters here given presumably apply to the genus.

Eggs laid singly.

Remarks.—This genus is close to *Tucumania* and has many characters in common with *Olyca*. The latter, however, has veins 3 and 5 of the hind wing connate, the ductus seminalis from the bursa rather than from the ductus bursae, the male labial palpus oblique, the aedeagus stout, and the basal plate of the anellus narrowly sclerotized. The characters separating *Eremberga* from *Tucumania* have been discussed in connection with the latter genus.

Three species are here recognized as belonging to *Eremberga*.

Its distribution is the southwestern part of the United States and Mexico.

KEY TO THE SPECIES OF EREMBERGA

1. A conspicuous, blackish, discal spot on fore wing at end of cell. 3. insignis, new species
 No such discal spot on fore wing 2
2. General color of fore wing pale slate-gray 1. leuconips (Dyar)
 Predominant colors of fore wing white and luteous 2. creabates (Dyar)

1. EREMBERGA LEUCONIPS (Dyar)

PLATES 29, 39, 49; FIGURES 22–22c, 55–55a, 118–118a, 119–119a

Cactobrosis leuconips DYAR, Insecutor Inscitiae Menstruus, vol. 13, p. 224, 1925; Proc. Ent. Soc. Washington, vol. 30, p. 136, 1928.

Male.—Palpi, head, thorax, and fore wings grayish fuscous densely sprinkled with white, giving the insect a pale slate color. Labial palpus banded with blackish fuscous toward the ends of the segments. Fore wing with veins 3 to 10 outlined in black, the black scaling especially strong on lower vein of cell; antemedial and subterminal lines very fine and faint but usually discernible, black; antemedial line acutely angulate and irregularly sinuate and dentate, more or less broken and normally obliterated at costa; subterminal line also ir-

regularly sinuate and dentate, decidedly slanting, obscured toward costa; no distinct discal marks at end of cell and no dots along termen. Hind wing glistening white, semihyaline with a band of fuscous shading along costa and a fine pale-fuscous line along termen for a short distance from apex.

Alar expanse, 27–37 mm.

Genitalia (figs. 22–22c) with lateral edges of anellus finely and irregularly serrate; vinculum with terminal margin evenly rounded, lateral margins not concave or excavate.

Female.—Color and markings as in the male except hind wings dark smoky fuscous, the fuscous shading extending into the cilia and strongly outlining most of the veins; hind wings paler toward their bases.

Alar expanse, 26–37 mm.

Genitalia (figs. 55–55a) without any trace of signum; bursa nearly smooth; ductus seminalis from ductus bursae a short distance from genital opening.

Type.—In United States National Museum.

Type locality.—Baboquivari Mountains, Ariz.

Food plant.—*Echinocereus polyacanthus* Engelmann.

Distribution.—UNITED STATES: *Arizona*, Baboquivari Mountains (July, Sept.), Roosevelt (July), Oracle (July), Huachuca Mountains (Aug.), Chiricahua Mountains, Mohave County (Sept.).

Eighteen specimens examined.

Remarks.—This species bears a strong resemblance to *Cactobrosis strigalis* (Barnes and McDunnough) and might easily be confused with it. The latter, however, has filiform maxillary palpi while those of *leuconips* are distinctly squamous. Dyar seems to have overlooked this character in placing many of his species. Also there is a difference in the longitudinal markings. In *strigalis* the strongest black longitudinal line is that along the top of the cell and vein 6, while in *leuconips* the strongest line is that along the lower vein of the cell.

In two males and some of the females of *leuconips* there is a faint brownish-fuscous suffusion on the lower third of the fore wing (bordering the inner margin), but this is not distinguishable on all specimens and does not seem to be a specific character.

2. EREMBERGA CREABATES (Dyar)

Plates 29, 49; FIGURES 24–24c, 120–120a

Olyca creabates DYAR, Insecutor Inscitiae Menstruus, vol. 11, p. 29, 1923.
Cactobrosis creabates (DYAR), Proc. Ent. Soc. Washington, vol. 30, p. 136, 1928.

Male.—Palpi grayish fuscous. Head grayish fuscous shaded with white. Thorax luteous, whitish toward anterior margin. Fore wing

with basal area (to antemedial line), and all the area between antemedial and subterminal transverse dark shade and the fold and costa, white; area between fold and inner margin luteous; outer area (beyond subterminal dark shade) ashy white, shading to luteous at tornus; transverse antemedial line well contrasted against ground color, thin, black, irrorate, forming a sharp angle at the fold, the apex of the angle extending almost to the middle of the fold; subterminal line obsolete, replaced by a dark, transverse shade below end of cell and some scattered blackish dusting toward apex; veins 2 to 10 and upper and lower veins of cell more or less outlined in black, the lines very faint on all the veins except vein 4; along termen, between the vein ends, a row of very faint blackish dots; no discal marks at end of cell. Hind wing shiny white, semihyaline, with a faint pale-fuscous shading along costa, on veins 6, 7, and 8, and at extreme apex.

Alar expanse, 34 mm.

Genitalia (figs. 24–24c) with lateral margins of anellus smooth; vinculum with terminal margin straight, rather broad, lateral margins excavate.

Female.—Unknown.

Type.—In United States National Museum.

Type locality.—San Diego, Calif. (July).

Food plant.—Unknown.

Remarks.—Known only from the unique male type. It is a striking species and should be easily recognized from the description and genitalic figures.

3. EREMBERGA INSIGNIS, new species

PLATE 29; FIGURES 23–23c

Male.—Palpi, face, head, thorax, and fore wing dark grayish fuscous. Fore wing very faintly dusted with white on costal half; lower half of wing faintly shaded with dull luteous-ocherous; antemedial and subterminal lines as in *leuconips*, except antemedial not obliterated toward costa; veins 2 to 9 very faintly outlined in black, the black lining most distinct on lower vein of cell; a conspicuous black spot at end of cell; along termen, between the vein ends, a row of rather conspicuous black dots. Hind wing shiny white, semihyaline, with a fuscous shade bordering costa and a pale fuscous line on termen for a short distance from apex.

Alar expanse, 35 mm.

Genitalia (figs. 23–23c) with lateral margins of anellus smooth; vinculum with terminal margin straight and narrow, lateral margins outwardly angled.

Female.—Unknown.

Type.—U.S.N.M. no. 52754.

Type locality.—San Luis Potosi, Mexico.

Food plant.—Unknown.

Remarks.—Described from male type dated July 26, 1930, and submitted by R. C. Mundell. The specimen may have been reared, but the label gives no food plant, and the assumption is that it was merely a collected specimen. A female, collected on July 19 in the same locality and sent as a presumptive female of the same species, is a *Yosemitia* close to and closely resembling *graciella.* I think it is undescribed and have figured the genitalia (fig. 56), but I am not naming it as the moth is in too poor condition for accurate determination.

E. insignis is easily distinguished from the other two species in the genus by the conspicuous discal spot on the fore wing. The palpi were not figured, as they are like those of *leuconips.*

12. SALAMBONA, new genus

Genotype.—Zophodia analamprella Dyar.

Antenna of male pubescent and slightly serrate, of female simple and shortly pubescent. Labial palpi of both sexes porrect with the third segments downcurved, the third segment slightly longer in the female than in the male. Maxillary palpus squamous. Hind wing with veins 7 and 8 anastomosed for more than one-half their length beyond the cell; 3 and 5 stalked. Eighth abdominal segment with a pair of strong ventrolateral hair tufts.

Male genitalia with apical process of gnathos bifid, small; uncus constricted toward apex; harpe with apex oblique; vinculum long; anellus with base of plate narrowly sclerotized, arms long, curved and twisted part way around aedeagus; aedeagus long, stout.

Female genitalia without signum or scobinations in bursa; bursa small, smooth; ductus bursae long, slender, smooth; ductus seminalis from near end of bursa.

Larvae "grayish-green or blackish" (Dodd), not banded or conspicuously spotted; solitary feeders in fruits of *Platypuntia.*

Eggs laid singly.

Remarks.—The genus is distinguished from other genera in the cactus-feeding group by the following combination of characters: Antenna of male serrate and pubescent; labial palpi of both sexes porrect and downcurved; maxillary palpus squamous; harpe of genitalia with apex oblique; vinculum long; eighth abdominal segment of male bearing a pair of ventrolateral tufts; bursa copulatrix of female small and without signum or scobinations (smooth); ductus seminalis from near end of bursa; larvae unbanded, dark, fruit feeders in *Platypuntia.*

Only the type species is recognized as belonging to the genus. It is known only from Argentina.

1. SALAMBONA ANALAMPRELLA (Dyar)

PLATES 30, 42, 49; FIGURES 26–26c, 69, 116–116a, 117–117a

Zophodia analamprella DYAR, Insecutor Inscitiae Menstruus, vol. 10, p. 17, 1922.

Male.—Palpi, head, thorax, and fore wings dark stone gray; the scales under magnification dark grayish fuscous tipped with dull white. Fore wing with the costa broadly margined (to top of cell) with white, the white streak diminishing toward base of wing and terminating before apex; no transverse lines, or discal or terminal dots. Hind wing semihyaline with a smoky shade along costa and a narrow smoke-brown line along termen.

Alar expanse, 25–27 mm.

Genitalia (figs. 26–26c) as figured; characters as given for the genus.

Female.—Color and markings as in the male, except that the smoky shade is somewhat more extended on the hind wing.

Alar expanse, 25–27 mm.

Genitalia (fig. 69) with bursa very small and ductus bursae long and very slender.

Type.—In United States National Museum.

Type locality.—Carmen Patagones, Argentina.

Food plant.—*Opuntia* (*Platypuntia*) *sulphurea* G. Don and probably other species of *Platypuntia.*

Distribution.—ARGENTINA: Carmen Patagones (Jan.), Andalgala (Mar.), La Rioja.

Seven specimens examined.

Remarks.—Dodd states that "this insect is usually predacious on cochineal (*Dactylopius* spp.) but not uncommonly the larvae feed in *Opuntia* fruit and flower buds." From the genitalic and other structural characters of the moth I am inclined to doubt this. I think *analamprella* will prove to be primarily a cactus feeder and only secondarily predacious on the cochineal scales on the cactus. It is the other way around with *Laetilia coccidivora* (Comstock). The latter is a true predator and follows its coccid hosts no matter to what plant they may go. It also varies its diet somewhat by occasional feedings on buds and flowers. According to Dodd it sometimes feeds in *Opuntia* flowers; but this is a secondary habit and the association with *Opuntia* accidental. *Laetilia* is close to but not a part of the cactus-feeding group of Phycitinae. *Salambona*, on the other hand, is, in all adult characters, definitely a member of the group.

The species is a striking one, easily recognized by the white costal stripe on the fore wing. It most resembles some species now under *Epischnia*. The latter, however, have 8-veined hind wings and need not be confused.

13. Genus PAROLYCA Dyar

Parolyca DYAR, Proc. Ent. Soc. Washington, vol. 30, p. 17, 1928. (Genotype: *Olyca asthenosoma* Dyar.)

Antenna of male unipectinate. Labial palpus of male upcurved. Maxillary palpus squamous. Hind wing with veins 7 and 8 shortly anastomosed beyond cell; 3 and 5 shortly stalked. Eighth abdominal segment with a strong pair of ventrolateral tufts.

Male genitalia with apical portion of gnathos bifid; uncus narrowed well before apex; harpe with apex oblique; vinculum long, its terminal margin rounded, its lateral margins excavate (probably a specific character only); anellus with base of plate broadly sclerotized, arms long, rather broad and slightly twisted; aedeagus long, stout; penis weakly scobinate.

Remarks.—The genus is known only from the male of its type species. Its biology is unknown, but from the genitalic and other structural characters of the adult its larvae are presumed to be cactus feeders. It is easily recognized, for it is the only genus in the cactus-feeding group with unipectinate antenna. The habitat is French Guiana.

1. PAROLYCA ASTHENOSOMA (Dyar)

PLATES 30, 49; FIGURES 25–25c, 124–124a

Olyca asthenosoma DYAR, Insecutor Inscitiae Menstruus, vol. 7, p. 55, 1919.
Parolyca asthenosoma (DYAR), Proc. Ent. Soc. Washington, vol. 30, p. 137, 1928.

Male.—Palpi, head, and thorax sordid white. Fore wing white, with a yellowish tint on area between fold and inner margin; antemedial band angulate, consisting of parallel black lines and a central white line; a black oblique dash in median area from inner margin to origin of vein 2; subterminal line broken, indicated by a pair of black dashes at apex, black dots on the veins, and a black spot on inner margin; a black discal dot at end of cell and some black scaling on bases of veins 2 to 4; a row of small black dots along termen, between the vein ends. Hind wing white, semihyaline, with a pale-fuscous shade along costa, a narrow fuscous line along termen, and some pale fuscous scaling on veins 2 to 8.

Alar expanse, 30 mm.

Genitalia (figs. 25–25c) with lateral margins of vinculum excavate.

Female.—Unknown.

Type.—In United States National Museum.
Type locality.—Maroni River, French Guiana.
Food plant.—Unknown.
Remarks.—Known only from the unique male type.

14. SIGELGAITA, new genus

Genotype.—*Sigelgaita chilensis*, new species.

Antenna of male bipectinate (in *transilis* with a few flattened setae on the inner row of pectinations of the first five or six segments of the shaft and also on the same segments); antenna of female shortly pubescent. Labial palpus of male upcurved, of female porrect (the second segment obliquely upturned, the third bent forward). Maxillary palpus large, extending above front, flamboyant. Hind wing with veins 7 and 8 anastomosing beyond cell; 3 and 5 stalked. Eighth abdominal segment with two pairs of thin hair tufts (very slight in *chilensis*).

Male genitalia with apical process of gnathos small, bifid; harpe with apex oblique; vinculum long; anellus with base of plate somewhat broadly sclerotized, arms moderately long, slightly twisted (in *transilis*); aedeagus moderately stout, long; penis weakly scobinate.

Female genitalia with signum weak or absent; bursa small and finely scobinate; ductus bursae moderately long, finely scobinate toward bursa and genital opening; ductus seminalis from middle of bursa.

Larva "blue or blue green" (Dodd), not banded or conspicuously spotted; two setae in group VII on abdominal segments 7 and 8.

The larvae are solitary feeders in the fruits of *Eulychnia*, *Trichocereus*, and *Platypuntia*.

Egg and egg-laying habits unknown.

Remarks.—This genus is closest to *Amalafrida* but in many characters more nearly resembles *Nanaia*. The maxillary palpi are long in both *Sigelgaita* and *Nanaia* but are not so closely appressed to the face in the former as in the latter. The labial palpi of the males (upcurved in *Sigelgaita*, porrect in *Nanaia*) readily separate the two genera.

KEY TO THE SPECIES OF SIGELGAITA

1. Fore wing with a dark shade from outer end of cell to inner margin; alar expanse over 30 mm 2
 Fore wing with no such marking; alar expanse less than 30 mm. 3. transilis, new species
2. General color of fore wing dark gray (from Chile) 1. chilensis, new species
 General color of fore wing pale brownish fuscous (from Peru). 2. huanucensis, new species

1. SIGELGAITA CHILENSIS, new species

PLATES 31, 42, 50; FIGURES 28–28c, 70–70a, 125–125a, 126

Male.—Palpus, head, and thorax fuscous, strongly irrorated with white; head and collar more whitish than fuscous; posterior margin of thorax shaded with black. Fore wing fuscous, dusted with white, giving the wing an ashy-gray (in some specimens a bluish-gray) color; a white suffusion filling the cell; antemedial line near middle of wing, black, outwardly angulate; from upper angle of cell to middle of inner margin a more or less prominent blackish shade; subterminal band dentate, consisting of a thin, black, inner line, a parallel outer black line, and a central pale line, the dentations of the outer line acute and extended in short dashes onto the veins; a row of black dots along termen between the vein ends. Hind wing whitish, smoky-fuscous toward termen, apex, and costa, and on the veins; cilia white with a pale-fuscous subbasal line.

Alar expanse, 31–42 mm.

Genitalia (figs. 28–28c) with harpe fairly broad, aedeagus somewhat stouter than in *transilis*, vinculum shorter.

Female.—Pattern and color as in the male except smoky-fuscous shading on hind wing somewhat more extended.

Alar expanse, 38–44 mm.

Female genitalia (figs. 70–70a) with signum present, the latter consisting of three or four minute, more or less coalesced, blunt spines.

Type and paratypes.—U.S.N.M. no. 52751. Paratypes also sent to Mr. Dodd.

Type locality.—Ovalle, Chile.

Food plants.—*Eulychnia acida* Philippi, *Trichocereus chiloensis* (Colla).

Remarks.—Described from male type and two male and four female paratypes from the type locality, reared March 7, 9, 10, and 11, 1937, from larvae feeding in fruits of *Eulychnia acida;* and two male and four female paratypes from La Serena, Chile, reared January 6, 12, 13, 1937, from larvae feeding in fruits of *Trichocereus chiloensis.*

Superficially this species and *huanucensis* resemble *Nanaia substituta.* The latter, however, lacks altogether the dark shade between the outer angle of the cell and the inner margin so characteristic of *chilensis* and *huanucensis.* The fore wings of the three species are similar, long and narrow and of about the same size and shape.

2. SIGELGAITA HUANUCENSIS, new species

PLATE 42; FIGURES 71–71a

Male.—Similar to that of *chilensis*, except as follows: Paler, white dusting on head, thorax, and fore wing more pronounced; general

color of fore wing brownish rather than gray; transverse dark shade from outer upper angle of cell to inner margin pale brown; antemedial and subterminal lines interrupted, the latter indicated only by blackish scaling on the veins; a pale brownish shade in area bordering inner margin; hind wing pure white, with a very faint fuscous shade along costa and a thin pale-fuscous line on termen for a short distance from apex.

Alar expanse, 45 mm.

Female.—Similar to the male in color and markings except that on the hind wing the fuscous line on the termen is a trifle broader and extends nearly to the anal angle of the wing. There is also some fuscous scaling on the veins.

Alar expanse, 45 mm.

Genitalia (figs. 71–71a) without signum.

Type and paratype.—U.S.N.M. no. 52752.

Type locality.—Huánuco, Peru.

Food plant.—*Opuntia* (*Platypuntia*) *ficus-indica* (Linnaeus).

Remarks.—Described from female type and male paratype from the type locality, reared December 12, 1928, by R. C. Mundell from larvae feeding in the fruits of *Opuntia* (*Platypuntia*) *ficus-indica.*

The male paratype was in rather poor condition when received and had no abdomen.

3. SIGELGAITA TRANSILIS, new species

PLATES 30, 50; FIGURES 27–27d, 127–127c

Male.—Palpi, head, thorax, and fore wing dark grayish fuscous finely peppered with white, giving them a slate-gray color. Fore wing with antemedial and subterminal lines obscured, indicated by faint whitish lines bordered, for a short distance from costa, by blackish streaks; discal spot at end of cell blackish, rather large; a row of black dots along termen between the vein ends.

Alar expanse, 26 mm.

Genitalia (figs. 27–27c) with harpe narrower than that of *chilensis*, vinculum considerably longer, and aedeagus slenderer and appreciably tapering toward apex.

Female.—Unknown.

Type.—U.S.N.M. no. 52753.

Type locality.—Santa Eulalia, Peru.

Food plant.—*Trichocereus* sp.

Remarks.—Described from male type reared November 26, 1936, by Johannes Wille from larva feeding in fruit of an undetermined species of *Trichocereus* (Wille no. 329–36).

On some of its characters this species would fit better in the following genus (*Amalafrida*) than in *Sigelgaita*. The male antenna (figs. 127a–c) has flattened setae on the first five or six segments of the shaft. In *transilis* these setae are on the shaft itself as well as on the inner row of pectinations. Neither *chilensis* nor *huanucensis* shows any trace of such setae. This one character, however, is all that suggests association with *Amalafrida leithella*. The maxillary palpus and the larval habits show that *transilis* belongs with *chilensis* and *huanucensis* rather than with *leithella*.

15. AMALAFRIDA, new genus

Genotype.—Cactoblastis leithella Dyar.

Antenna of male bipectinate; on each of the inner pectinations of the first five segments a row of from three to five flattened, spinelike setae (figs. 128a–c); antenna of female simple and finely pubescent. Labial palpus of male obliquely ascending, of female obliquely porrect. Maxillary palpus squamous. Hind wing with veins 7 and 8 anastomosing for over half their length beyond cell; veins 3 and 5 stalked. Eighth abdominal segment of male with two pairs of ventrolateral hair tufts.

Male genitalia with apical process of gnathos bifid; harpe with apex oblique; vinculum long; anellus with base of plate rather broadly sclerotized, arms long, slightly twisted; aedeagus long, moderately stout; penis scobinate.

Female genitalia without signum; bursa copulatrix large, weakly and scatteringly scobinate; ductus bursae long, slender; ductus seminalis from about middle of bursa.

Larvae "grayish in color with a tendency toward pale transverse bands after the manner of *Olycella* larvae" (Dodd); solitary tunnelers in *Platypuntia*.

Egg unknown.

Remarks.—The genus, at present, is represented by only the type species. When Dyar described the latter he had only one female before him. Had he seen a male he never would have placed it in *Cactoblastis*, to which the moth bears only a superficial resemblance. The new genus is closest to *Sigelgaita*, one species of which (*transilis*) also has setiferous pectinations on some of the basal segments of the male antennal shaft. The form of the maxillary palpi, as well as the shape of the fore wings, distinguishes the two genera. In *Sigelgaita* the fore wing is much longer in proportion to its width and the termen more rounded than is the case in *Amalafrida*. According to Dodd, *leithella* differs markedly from the species of *Sigelgaita* in larval and pupal habits.

1. AMALAFRIDA LEITHELLA (Dyar)

PLATES 31, 42, 50; FIGURES 29–29d, 68–68a, 128–128c, 129

Cactoblastis leithella DYAR, Proc. Ent. Soc. Washington, vol. 30, p. 185, 1928.

Male.—Palpi whitish, peppered with pale fuscous. Head and thorax ocherous-fuscous with a very faint rufous tint, some white dusting on thorax and the thoracic hind margin shaded with black. Fore wing with the areas between cell and costa, between vein 1b and inner margin for a short distance, and along costal half of termen white with a scattering of black scales; ground color of remaining areas ocherous-fuscous, very faintly shaded with rufous above inner margin; transverse and discal markings black; antemedial line incomplete, indicated by a thin, blackish, irregular line from inner margin to cell and a broad black streak from costa to about middle of the fold (in some specimens this fuses with a black streak, which extends from middle of vein 1b to end of cell); subterminal line black, faint (obscured below vein 6 in some specimens), sinuate and dentate, outwardly bordered by a whitish line and beyond this by a second, very faint, parallel, pale-fuscous line; at end of cell a large, irregular, black spot; a line of distinct black dots along termen between the vein ends. Hind wing white, semihyaline, with a narrow pale-fuscous shade along costa and termen; cilia white with a fuscous basal band.

Alar expanse, 30–32 mm.

Genitalia (figs. 29–29c) with characters as given for the genus.

Female.—Similar to the male in color and markings except hind wing dark smoky fuscous shading to white toward base.

Alar expanse, 31–33 mm.

Genitalia ,figs. 68–68a) with bursa very large and irregularly shaped, minutely scobinate.

Type.—In United States National Museum.

Type locality.—Curaçao, Dutch West Indies.

Food plant.—*Opuntia* (*Platypuntia*) sp.

Distribution.—DUTCH WEST INDIES: Curaçao (Jan.). VENEZUELA: Caracas (Jan.). COLOMBIA: Province of Colombia (Jan.).

Nine specimens examined.

Remarks.—Superficially *leithella* resembles *Cactoblastis cactorum* but is easily distinguished on structural characters of the male and female genitalia and of the male antennae.

16. Genus OZAMIA Ragonot

Ozamia RAGONOT, Mémoires sur les Lépidoptères, vol. 8, p. 84, 1901. (Genotype: *Trachonitis lucidalis* Walker.)

Antenna of male serrate (except in *hemilutella* and *punicans*, where it is simple) and pubescent with a series of modified, papilla-

like setae on the inner side of several basal segments of the shaft (fig. 180a); antenna of the female simple and pubescent. Labial palpi obliquely ascending in both sexes. Maxillary palpus squamous. Hind wing with veins 7 and 8 anastomosing beyond the cell; 3 and 5 stalked. Eighth abdominal segment bearing one pair or two (*odiosella*) pairs of ventrolateral hair tufts.

Male genitalia with apex of gnathos small or moderately large, bifid; apex of harpe oblique (except in *punicans*); vinculum long; anellus with base of plate broadly rather than narrowly sclerotized, arms long, slightly twisted and curved; aedeagus rather long and moderately stout (except in *lucidalis*); penis scobinate.

Female genitalia with signum weak or absent (*lucidalis*), when present developed as a thin, short, scobinate or shortly thorned plate or a series or cluster of small, weak spines; bursa copulatrix minutely scobinate, at least toward ductus bursae (wrinkled in the South American species); ductus bursae long or moderately long, scobinate toward bursa; ductus seminalis from bursa near signum.

Larvae wine-colored, olive-green, or blackish, not banded or conspicuously spotted; with two setae in group VII of abdominal segments 7 and 8; solitary feeders in fruits and flower buds of *Opuntia* and *Cereus*, sometimes (some South American species) in the stems of *Cereus*.

Eggs laid singly.

Remarks.—This genus divides into two natural groups: The North American species with unwrinkled bursa and minutely scobinate ductus bursae, and all fruit or bud feeders, and the South American species with wrinkled bursa and coarsely scobinate ductus bursae and either fruit or stem feeders. The West Indian species (*lucidalis*) is anomalous in some genitalic characters (small abdominal tufts, rather slender aedeagus, long ductus bursae, and no signum), but on habitus and other characters it appears closely allied to the North American group. When males of all the species are known it may be possible to give a separate generic designation to the South American forms, but in the absence of definitive male characters that does not seem justified.

The papillalike setae in the male antennal shaft of *Ozamia* also occur in *Cactobrosis* and *Zophodia*, but the last two genera are distinguished by filiform maxillary palpi.

Seven species are here recognized as belonging to the genus. Its distribution appears to be the southwestern part of the United States, Central and South America, and the West Indies.

KEY TO THE SPECIES OF OZAMIA

1. Fore wing dark gray with white transverse antemedial and subterminal lines, but with very little white marking or dusting otherwise 4. **thalassophila** Dyar
 Fore wing sordid white or gray, heavily dusted with white in some areas 2
2. Predominant color of moth sordid white; ductus bursae of female finely scobinate (West Indies, North and Central America) 3
 Predominant color of moth gray; ductus bursae of female coarsely scobinate (South America) 5
3. Area bordering inner margin of fore wing shaded with ferruginous; female without signum (West Indies) 1. **lucidalis** (Walker)
 Area bordering inner margin of fore wing not ferruginous; female with signum (United States and Mexico) 4
4. Fore wing with a greenish tint on area bordering inner margin (discernible only in fresh specimens); signum of female a short line of minute spines (southern California). 3. **odiosella fuscomaculella** (Wright)
 No such greenish tint on fore wing; signum of female a narrow, minutely spined plate (Texas and eastern Mexico) ... 2. **odiosella** (Hulst)
5. General color of fore wing dark gray; midcostal half of wing white finely peppered with black 5. **stigmaferella** (Dyar)
 General color of fore wing paler gray; midcostal half of wing ashy white (an even peppering of whitish and fuscous scales) 6
6. Fore wing with large pale rust-colored blotches at base and on inner half 7. **punicans**, new species
 Fore wing with area between lower vein of cell, vein 2, and inner margin clear yellow and unmarked 6. **hemilutella** Dyar

1. OZAMIA LUCIDALIS (Walker)

PLATES 32, 41; FIGURES 30–30e, 66–66a

Trachonitis lucidalis WALKER, List of specimens of lepidopterous insects in the collection of the British Museum, vol. 27, p. 39, 1863.

Ozamia lucidalis (Walker) RAGONOT, Mémoires sur les Lépidoptères, vol. 8, p. 34, 1901.

Male.—Palpi, head, thorax, and fore wing sordid white. Fore wing with ferruginous-fuscous spottings on the area bordering inner margin; transverse markings black, shading to ferruginous-fuscous toward inner margin; antemedial line angulate, white, bordered on inner and outer sides by black or ferruginous, the outer black marking at costa a broad spot; subterminal line dentate, slanting from costa near apex to outer fourth of inner margin, bordered inwardly and outwardly by dark lines, shading from black to ferruginous; discal spot at end of cell irregular, frequently extended beyond cell into two short dashes, black; a row of black dots along termen at the vein ends. Hind wing white, semihyaline, with a fine fuscous line along termen; cilia white with a faint, dark, subbasal line. Abdominal tufts small.

Alar expanse, 25–26 mm.

Genitalia (figs. 30–30d) with apical process of gnathos small; end of vinculum bluntly rounded.

Female.—Similar to the male in color and markings, except for a stronger fuscous line on termen of hind wing.

Alar expanse, 26–30 mm.

Genitalia (figs. 66–66a) without signum; bursa and part of ductus bursae minutely scobinate; ductus bursae long, slender, bent at middle.

Type.—In British Museum.

Type locality.—Santo Domingo.

Food plant.—*Opuntia* (*Platypuntia*) sp.

Distribution.—West Indies: *Cuba*, *Jamaica*, Kingston (Jan.). I have seen no specimens from the type locality.

Seven specimens examined.

Remarks.—This species is easily identified by the characters given in the key. It has the smallest bursa of any *Ozamia*, and there is no trace of a signum.

2. OZAMIA ODIOSELLA (Hulst)

Plates 33, 41; Figures 33–33d, 34, 64–64a

Nephopteryx odiosella Hulst, Entomologica Americana, vol. 3, p. 132, 1887.

Salebria odiosella (Hulst), Trans. Amer. Ent. Soc., vol. 17, p. 155, 1890; U. S. Nat. Mus. Bull. 52, p. 425, 1903.—Ragonot, Mémoires sur les Lépidoptères, vol. 7, p. 366, 1893.—Barnes and McDunnough, Check list of the Lepidoptera of Boreal America, no. 5645, 1917.

Ozamia clarefacta Dyar, Insecutor Inscitiae Menstruus, vol. 7, p. 55, 1919. (New synonymy.)

Male.—Ground color and markings similar to those of *lucidalis* except that transverse markings are blackish throughout, paling somewhat toward inner margin but not shading into ferruginous; no ferruginous coloring on fore wing. In fresh specimens a green shading on area bordering inner margin of fore wing and on collar of thorax. Abdominal tufts (fig. 33d) much stronger than in *lucidalis* and in two distinct pairs.

Alar expanse, 23–28 mm.

Genitalia (figs. 33–33c, 34) with apical process rather large; end of vinculum bluntly angulate.

Female.—Similar to the male in color and markings except that the fuscous line along the termen of the hind wing is a trifle stronger.

Alar expanse, 24–28 mm.

Genitalia (figs. 64, 64a) with signum a narrow, minutely spined plate; bursa copulatrix smooth except toward ductus bursae, where it is finely scobinate; ductus bursae of moderate length, swollen toward bursa.

Types.—In United States National Museum (*odiosella* and *clarefacta*).

Type localities.—Texas (*odiosella*); Orizaba, Mexico (*clarefacta*).

Food plants.—*Opuntia* (*Platypuntia*) spp.

Distribution.—UNITED STATES: *Texas*, Brownsville, Victoria (May), Burnet County (Oct.), Uvalde (June, July), Kerrville (May, June), San Benito (Aug.). MEXICO: Orizaba (Apr.), Jalapa.

Twenty-two specimens examined.

Remarks.—In the original description of *odiosella* Hulst called his specimen a male and gave the type locality as Colorado. In his 1890 paper he gives the locality as "central Texas" and shifts the species from *Nephopteryx* to *Salebria*. Why he ever put it in either genus is a mystery; for it obviously has but seven veins in the hind wing. What is presumably Hulst's original type is before me. It came from the Fernald collection and bears Hulst's label: "*Nephopteryx odiosella* Hulst, Type, Tex." It is a female, as is Dyar's type of *clarefacta*. Dyar evidently considered his name a synonym for he had all the North American specimens under *odiosella* with *clarefacta* placed after it. The two types are identical in genitalic structure, color, and markings.

3. OZAMIA ODIOSELLA FUSCOMACULELLA (Wright), new combination

PLATES 32, 41, 50; FIGURES 31–31c, 67, 130–130a

Euzophera fuscomaculella WRIGHT, Ent. News, vol. 27, p. 27. 1916.—BARNES and MCDUNNOUGH, Check list of the Lepidoptera of Boreal America, no. 5723, 1917.

Ozamia heliophila DYAR, Insecutor Inscitiae Menstruus, vol. 13, p. 222, 1925. (New synonymy.)

This variety is distinguished from typical *odiosella* only by its distribution, the lack of any green shading along the inner margin of the fore wing (a character seen only in fresh specimens), and the character of the signum of the female. In *fuscomaculella* the signum consists of a thin, short line of minute spines. A paratype (male) of *fuscomaculella* from the Barnes collection is before me. It agrees in every detail with the male type of *heliophila*.

Types.—In collection of W. S. Wright (*fuscomaculella*); United States National Museum (*heliophila*).

Type localities.—San Diego, Calif. (*fuscomaculella*); Los Angeles, Calif. (*heliophila*).

Food plants.—*Opuntia* (*Platypuntia*) spp.

Distribution.—UNITED STATES: *California*, San Diego (May, June, Aug.), Los Angeles (July), Pasadena (Aug.).

Twelve specimens examined.

Remarks.—I was inclined to treat *fuscomaculella* and *heliophila* as nothing more than synonyms of *odiosella*, but Mr. Dodd informs

me moths of *odiosella* (=*olarefacta*), when alive, have a decidedly greenish tint, while living adults of *fuscomaculella* (=*heliophila*) are uniformly "gray" with no suggestion of green, and that this difference corresponds with the distribution of the two forms; namely, southeastern Texas and eastern Mexico as against the coastal region of southern California. Such differences seem to indicate geographical races, but, in view of the similarity of the two forms otherwise, not distinct species.

4. OZAMIA THALASSOPHILA Dyar

PLATES 41, 50; FIGURES 63–63a, 131–131a

Ozamia thalassophila DYAR, Insecutor Inscitiae Menstruus, vol. 13, p. 15, 1925.

Female.—Palpi, head, thorax, and fore wing dark grayish fuscous, lightly sprinkled with white. Fore wing with some white dusting on costal half and a slightly more brownish shade on inner half; antemedial and subterminal transverse lines whitish, bordered with black or blackish fuscous, the pattern as in *lucidalis* and *odiosella;* discal spot at end of cell curved, black; between this and subterminal lines one or two small, obscure, blackish dots; upper and lower veins of cell faintly outlined by white scales; a row of black dots along termen at or close to the vein ends; cilia pale ocherous-fuscous. Hind wing white with a narrow fuscous shade along termen; cilia white, with a fuscous subbasal line.

Alar expanse, 28 mm.

Genitalia (figs. 63–63a) with signum a small cluster of two or three more or less fused and minute spines; bursa copulatrix partially wrinkled (in the region of the signum); ductus bursae of moderate length, finely scobinate toward bursa.

Type.—In United States National Museum.

Type locality.—Oceanside, Calif.

Food plant.—*Opuntia* (*Cylindropuntia*) sp.

Remarks.—Known only from the unique female type, reared August 1924 from larva in a *Cylindropuntia*, presumably feeding in the fruit.

5. OZAMIA STIGMAFERELLA (Dyar), new combination

PLATE 41; FIGURES 62–62a

Zophodia stigmaferella DYAR, Insecutor Inscitiae Menstruus, vol. 10, p. 17, 1922.

Female.—Palpi, head, and thorax dark grayish fuscous sparsely sprinkled with white. Fore wing dark grayish fuscous; extreme base black; remainder of basal area and area between cell and costa and to the subterminal line white lightly dusted with black; antemedial line obsolete, indicated only by a large black spot on costa (cor-

responding to the black shade outwardly bordering the white antemedial line in the North American species of *Ozamia*); subterminal line whitish, dentate, bordered inwardly and outwardly by black; a short, dentate, black line from vein 8 to vein 2, midway between the end of cell and the subterminal line and parallel with the latter; a black curved mark at end of cell; a row of black dots along termen at or near the vein ends; a faint whitish color dusted with black in apical area. Hind wing white, semihyaline, with a fuscous shade at apex and for a short distance along termen; cilia whitish with a very faint fuscous subbasal line.

Alar expanse, 26 mm.

Genitalia (figs. 62–62a) with signum a small buttonlike thorn; bursa copulatrix wrinkled and finely scobinate; ductus bursae long, coarsely scobinate toward bursa.

Type.—In United States National Museum.

Type locality.—Catamarca, Argentina.

Food plant.—*Cereus validus* Haworth.

Remarks.—This species is known only from the female type reared March 7, 1921, by W. B. Alexander from a larva that had excavated a hollow in a stem of *Cereus validus*.

O. stigmaferella and the two following species (*hemilutella* and *punicans*) are the South American representatives of the genus and differ from the North American and West Indian forms in having the ductus bursae of the female coarsely scobinate and the bursa copulatrix decidedly wrinkled.

6. OZAMIA HEMILUTELLA Dyar

PLATES 33, 41; FIGURES 35–35d, 65–65a

Ozamia hemilutella DYAR, Insecutor Inscitiae Menstruus, vol. 10, p. 17, 1922.

Male.—Palpi, head, and thorax brownish fuscous, finely and evenly sprinkled with white, making the general color (to the naked eye) pale gray; collar of thorax with a slight yellowish tint. Fore wing with area between lower vein of cell, vein 2, and inner margin pale yellow without any markings; remainder of wing pale gray, concolorous with head and thorax; antemedial line obsolete; from costa just before middle to middle of lower vein of cell, a rather broad, transverse, brownish shade; a brown discal dot at end of cell and some brown shading just beyond; subterminal line faint, weakly dentate, parallel with termen, bordered inwardly and outwardly by thin faintly brownish lines; a row of minute black dots along termen at the vein ends; cilia pale gray. Hind wing white, semihyaline with a thin fuscous line along termen and some fuscous shading bordering the costa. Abdomen with one pair of strong tufts.

Alar expanse, 29 mm.

Genitalia (figs. 35–35c) with apical process of gnathos small; end of vinculum bluntly angulate.

Female.—Color and markings as in the male.

Alar expanse, 27–30 mm.

Genitalia (figs. 65–65a) with signum a single, weak, irregular, thornlike patch; bursa copulatrix wrinkled and finely scobinate; ductus bursae coarsely scobinate toward bursa.

Type.—In United States National Museum.

Type locality.—La Rioja, Argentina.

Food plant.—*Cereus validus* Haworth.

Distribution.—ARGENTINA: *Rioja*, La Rioja; *Santiago del Estro.*

Three specimens (one male and two females) examined.

Remarks.—The moth is easily identified by the clear yellow inner area of the fore wing. The larvae feed in the fruits and flower buds and, possibly, to some extent, in the stems of *Cereus.* Dodd states that they also attack fruits of Platypuntias.

7. OZAMIA PUNICANS, new species

PLATES 32, 40; FIGURES 32–32c, 61–61a

Male.—Palpi fuscous sprinkled with white. Head and thorax fuscous heavily dusted with white and more or less shaded with pale rust color, especially on top of head and on collar of thorax. Fore wing pale gray (fuscous heavily dusted with white) marked with darker gray and with large blotches of pale rust color; the rust shade filling about one-fourth of the basal area and nearly all the area between antemedial and subterminal lines, lower vein of cell, vein 2, and vein 1b; antemedial line obscure, indicated chiefly by a rather broad dark-gray shade from costa to lower vein of cell and a thin dark-gray line thence to inner margin; subterminal line faint, somewhat sinuate but not dentate, approximately parallel with termen, bordered inwardly and outwardly by obscure dark gray; apical mark at end of cell irregular, dark gray; between cell and subterminal line some faint rust shading in the interspaces between the veins; a row of black dots along termen between the vein ends; cilia pale rust-red. Hind wing white, semihyaline, with a fuscous shade in costal area to top of cell and vein 8, some fuscous shading on the vein ends, and a fine fuscous line along termen to vein 1b; cilia shiny white. Abdominal tufts as in *hemilutella.*

Alar expanse, 36–38 mm.

Genitalia (figs. 32–32c) with apical process of gnathos moderately large; apex of harpe more rounded than in other species of *Ozamia;* end of vinculum more rounded than angulate and lateral margins excavate; penis bearing a number of coarse spines.

Female.—Color and markings as in the male.

Alar expanse, 38–40 mm.

Genitalia (figs. 61–61a) larger than those of any other *Ozamia;* with signum a small granulose plate containing a stubby central thorn; bursa copulatrix wrinkled and finely scobinate; ductus bursae long, very coarsely scobinate toward bursa.

Type and paratypes.—U.S.N.M. no. 52755. Paratypes also sent to Mr. Dodd.

Type locality.—Tapia, Tucuman, Argentina.

Food plant.—*Cereus validus* Haworth.

Remarks.—Described from male type and two male and four female paratypes from the type locality and reared by R. C. Mundell October 19, 23, 25, 28, 29, and 31, 1936, and October 17, 1933, from larvae boring in the stems of *Cereus validus.*

According to Dodd *punicans* differs from other species of *Ozamia* in that it is a stem borer and apparently does not attack the fruits or flower buds. It differs also in that the apex of the harpe is not definitely oblique, and the maxillary palpi are somewhat narrowly scaled. However, the latter are of the squamous rather than the filiform type, and from its general habitus the species is obviously closely related to *hemilutella.* The moth can be easily identified by the rust-red cilia and blotches on the fore wing.

17. Genus CACTOBROSIS Dyar

Cactobrosis DYAR, Proc. U. S. Nat. Mus., vol. 47, p. 406, 1915; Proc. Ent. Soc. Washington, vol. 30, p. 135, 1928. (Genotype: *Moodna elongatella* Hampson.)

Antenna of male with a series of modified, papillalike setae on the inner sides of several basal segments of the shaft, bipectinate (*fernaldialis, longipennella*) or strongly serrate and pubescent (*maculifera, strigalis*); antenna of female simple and shortly pubescent. Labial palpus upturned in the male, oblique in the female. Maxillary palpus filiform (fig. 134a). Hind wing with veins 7 and 8 anastomosing beyond the cell; 3 and 5 shortly stalked. Eighth abdominal segment bearing a pair of ventrolateral hair tufts (the tufts long and dense except in *strigalis*).

Male genitalia with apex of gnathos large, bifid; apex of harpe evenly rounded; vinculum long (moderately long in *strigalis*); anellus with base of plate narrowly sclerotized, arms long, slender, slightly twisted; aedeagus long, stout (shorter and less stout in *strigalis*); penis more or less densely pubescent (armed with short hairlike spines).

Female genitalia without signum; ductus bursae long, finely scobinate only at genital opening or (in *strigalis* only) sparsely so at junction of bursa copulatrix and ductus bursae, with two small sclerotized dorsal plates and a single ventral plate at genital opening (the ventral plate absent in *strigalis*); bursa copulatrix large, smooth (except in *strigalis*, in which it has a few minute scobinations); ductus seminalis from near end of bursa.

Larvae bluish, not banded or conspicuously spotted; with two setae in group VII on abdominal segments 7 and 8; gregarious feeders in *Ferocactus*, *Echinocereus*, *Peniocereus*, and, probably, *Carnegiea*.

Eggs laid singly.

Remarks.—The genus as here defined is distinguished from all other genera of the cactus-feeding group by its filiform maxillary palpi. *Zophodia*, which it resembles in most structural characters, is not a cactus-feeding genus, has the male antenna unserrate, the labial palpus of the female porrect, and a small signum in the bursa copulatrix.

Five species are recognized as belonging to the genus. They are fairly easy to distinguish but subject to so much individual variation in wing markings that it is very difficult to key them satisfactorily.

The known distribution is the southwestern part of the United States and Mexico.

KEY TO THE SPECIES OF CACTOBROSIS

1. Fore wing without transverse markings and with veins strongly outlined in black, the strongest black line from base to termen along upper vein of cell and vein 6; abdominal tufts of male weak 5. **strigalis** (Barnes and McDunnough)

 Fore wing normally with transverse markings and with some black scaling on veins; but if transverse markings are absent, veins are not strongly lined nor is there a conspicuous black line from base to termen; abdominal tufts of male strong 2

2. Fore wing with a strong, submedian, luteous shade; thorax pale clay color 3. **maculifera** Dyar

 Fore wing sometimes with a faint ocherous-fuscous tint on submedian area, but never with a strongly contrasted luteous shade; thorax grayish fuscous 3

3. Fore wing without discal spot or transverse dark markings; a nearly uniform grayish fuscous with a faint brownish tint. 4. **insignatella** Dyar

 Fore wing normally with dark discal spot and transverse dark shadings; when suffused, pale slate-gray without brownish overtint 4

4. Pectinations of male antenna (at middle) longer than width of segments 1. **fernaldialis** (Hulst)

 Pectinations of male antenna not longer than width of segments. 2. **longipennella** (Hampson)

1. CACTOBROSIS FERNALDIALIS (Hulst)

PLATES 43, 51; FIGURES 73–73a, 134–134c, 135–135a

Megaphycis fernaldialis HULST, Trans. Amer. Ent. Soc., vol. 13, p. 163, 1886.

Euzophera gigantella RAGONOT, Nouveaux genres et espèces de Phycitidae et Galleriidae, p. 32, 1888; Mémoires sur les Lépidoptères, vol. 8, p. 51, 1901.

Melitara fernaldialis (HULST), Trans. Amer. Ent. Soc., vol. 17, p. 172, 1890; U. S. Nat. Mus. Bull. 52, p. 429, 1903.—SCHWARZ, Psyche, vol. 8, Suppl. 1, p. 13, 1899.—RAGONOT, Mémoires sur les Lépidoptères, vol. 8, p. 15, 1901.—HUNTER, PRATT, and MITCHELL, Bur. Ent., U. S. Dept. Agr. Bull. 113, p. 29, 1912.

Honora cinerella HULST, Journ. New York Ent. Soc., vol. 8, p. 223, 1901; U. S. Nat. Mus. Bull. 52, p. 433, 1903.

Melitara fernaldalis DYAR, Proc. Ent. Soc. Washington, vol. 7, p. 36, 1905. (Misspelling for *fernaldialis* Hulst.)

Cactobrosis fernaldalis (DYAR), Proc. U. S. Nat. Mus., vol. 47, p. 407, 1915; Insecutor Inscitiae Menstruus, vol. 13, p. 223, 1925 (in part); Proc. Ent. Soc. Washington, vol. 30, p. 135, 1928 (in part).

Cactobrosis fernaldialis (Hulst) BARNES and MCDUNNOUGH, Check list of the Lepidoptera of Boreal America, no. 5696, 1917.

Male.—Antenna bipectinate. Palpi, head, and thorax grayish fuscous dusted with white. Fore wing grayish fuscous dusted with white and more or less blotched with black; some specimens with a faint ocherous-fuscous tint in the middle of the cell and on the area between vein 1b and the cell; normally with antemedial and subterminal transverse markings indistinct, but indicated by whitish angulate and dentate bands shaded inwardly and outwardly by black; a blackish shade at end of cell, often extending to costa; below it on inner margin a similar dark spot; veins 2 to 8 faintly lined with black and in many specimens the fold to a little beyond its middle. Hind wing white, semihyaline, shaded in costal area above vein 6 and cell with pale fuscous, with some fuscous scaling on the veins and a fine fuscous line along termen; anal margin and adjoining cilia faintly ocherous; cilia otherwise white, with a narrow, fuscous, subbasal line.

Alar expanse, 36–47 mm.

Male genitalia essentially like those of *longipennella* but somewhat larger, in size and habitus like those of *maculifera.*

Female.—In color and markings like the male except that there is never any black streak on the fold of the fore wing; some specimens are heavily dusted with black over the entire base of the fore wing as far as the antemedial line; others have the transverse lines and contrasted dark spots almost obliterated and the wing of a pale slate-color with only the faintest remnants of the normal markings.

Alar expanse, 34–50 mm.

Genitalia (figs. 73–73a) with the sclerotized ventral plate in ductus bursae at genital opening smaller than those in *longipennella*, *insignatella*, and *maculifera.*

Types.—In Rutgers College collection (*fernaldialis*); United States National Museum (*cinerella*); Muséum National d'Histoire Naturelle, Paris (*gigantella*).

Type localities.—Arizona (*fernaldialis*, *gigantella*); Santa Rita Mountains, Ariz. (*cinerella*).

Food plants.—*Ferocactus wislizeni* (Engelmann) and probably other species of *Ferocactus; Peniocereus greggii* (Engelmann), one reared specimen from Maricopa County, Ariz., in National collection so labeled.

Distribution.—UNITED STATES: *Arizona*, Catalina Springs (Apr.), Oracle (July), Tucson (June), Baboquivari Mountains (Apr., May, June, July, Aug., Oct., Nov.), Christmas, Redington, Pinal Mountains, Santa Rita Mountains (May, June), Huachuca Mountains (Aug.), Douglas (Apr., May), Mohave County (May), Sells P. O. (Indian Oasis, Apr.), Dewey (June), Maricopa County (July), "en route from Dewey to Salome" (Apr., May); *California*, San Diego (May, Oct.).

Seventy-three specimens examined.

Remarks.—The synonymy as given here was established by Dyar. However (in 1915, 1925, and 1928), he also listed the Mexican species *longipennella* Hampson and its synonym *elongatella* under *fernaldialis*, incorrectly, I believe, because the forms from Mexico and the United States have different male antennae. In his original description of *gigantella* Ragonot gives the type locality as "Mexico or."; but in his Monograph of the Phycitinae he cites Arizona as the only locality. If the later citation is correct, *gigantella* is presumably a synonym of *fernaldialis*. If, however, eastern Mexico is the locality, the name *gigantella* will probably replace *longipennella* for the Mexican species. It is quite likely that *fernaldialis* also occurs in northern Mexico near the Arizona border; but we have no specimens from that country. All the specimens in the National collection that have been identified as *fernaldialis* are *longipennella*.

In addition to moths reared from *Ferocactus* and *Peniocereus* the National collection contains the moths referred to by E. A. Schwarz (Psyche, 1899) as reared from larvae "feeding in decaying pulp of the Giant Cactus." One of the specimens (a female) bears the following label in Schwarz's handwriting: "bred from cocoons under Giant Cactus. Em. Apr. 15." From this it would appear that *Carnegiea gigantea* (Engelmann) may also be an occasional host.

2. CACTOBROSIS LONGIPENNELLA (Hampson)

PLATES 34, 43, 51; FIGURES 37–37c, 74–74a, 136–136b

Euzophera longipennella HAMPSON, Mémoires sur les Lépidoptères, vol. 8, p. 52, 1901.

Moodna elongatella HAMPSON, Mémoires sur les Lépidoptères, vol. 8, p. 269, 1901.

Cactobrosis longipennella (Hampson) DYAR, Proc. U. S. Nat. Mus., vol. 47, p. 407, 1915.

Cactobrosis elongatella (Hampson) DYAR, Proc. U. S. Nat. Mus., vol. 47, p. 407, 1915.

Cactobrosis fernaldalis (DYAR, in part), Insecutor Inscitiae Menstruus, vol. 13, p. 223, 1925; Proc. Ent. Soc. Washington, vol. 30, p. 135, 1928.

Male.—Like that of *fernaldialis* except that pectinations of antenna are about half the length of those on *fernaldialis* (compare figs. 134a, 134b, and 136a, 136b); transverse pale markings on fore wing obsolete in some specimens.

Alar expanse, 34–40 mm.

Genitalia (figs. 37–37d) figured from type of *elongatella;* similar to those of *fernaldialis* except smaller; harpe not so markedly creased.

Female.—Similar in color and markings to the female of *fernaldialis.*

Alar expanse, 33–43 mm.

Genitalia (figs. 74–74a) figured from specimen from Oaxaca; with sclerotized ventral plate in ductus bursae at genitalic opening larger and the opposing small plates on the dorsal wall of the ductus narrower than those of *fernaldialis.*

Types.—In British Museum (*longipennella*); United States National Museum (*elongatella*).

Type localities.—Tres Marias Islands, Mexico (*longipennella*); Orizaba, Mexico (*elongatella*).

Food plant.—Unknown, probably *Ferocactus.*

Distribution.—MEXICO: Orizaba, Oaxaca, Tehuacan (June), Cuernavaca (June, July), Zacualpan (March, Oct.).

Eleven specimens examined. I have seen no examples from the type locality of *longipennella.*

Remarks.—Dyar (1925) made the synonymy of *longipennella* and *elongatella* and sank both names to *fernaldialis.* The differences between their male antennae clearly indicate that *longipennella* and *fernaldialis* are distinct, if very close, species. The differences in female genitalia, while slight, appear to be constant. They are comparative, however, and apparent only when one has slides of both species before him.

8. CACTOBROSIS MACULIFERA Dyar

PLATES 35, 43, 51; FIGURES 38–38d, 75–75a, 137–137a

Cactobrosis maculifera DYAR, Proc. U. S. Nat. Mus., vol. 47, p. 407, 1915; Proc. Ent. Soc. Washington, vol. 30, p. 136, 1928.

Male.—Antenna strongly serrate and fasciculate. Palpi, head, and thorax pale clay color ("luteous"). Fore wing luteous-gray

shaded and spotted with dark grayish fuscous, the luteous tint pronounced on basal third of costa and over the submedian area of the wing; transverse antemedial and subterminal lines obsolete; a fuscous shade from costa before middle to cell, another from costa at middle, and below these corresponding streaks or spots on lower vein of cell and vein 1b; a thin blackish line on the fold from its base to near its middle; a similar dark streak on vein 1b at outer third; short, broken, dark streaks on the veins at or near the cell; a clouded fuscous spot at end of cell; outer half of costa shaded with fuscous; a row of dark spots along termen at or very close to the vein ends. Hind wing white, semihyaline with only the faintest indication of a fuscous line on termen toward apex.

Alar expanse, 32–45 mm.

Genitalia (figs. 38–38d) agreeing in size and nearly all details with those of *longipennella* except that the arms of the anellus are a trifle longer in *maculifera*.

Female.—In color and pattern like the male except that there is some gray shading on the head and thorax and considerably more gray on the fore wing (the single specimen before me is in much better condition than the males, which may account for some of the differences); basal third of wing clouded with dark fuscous; terminal area more faintly clouded; subterminal line faintly indicated, sharply angulate at middle, broken below; the luteous shade more contrasted than in the male, but restricted to middle of cell and the area between veins 1b and the fold. Hind wing white, semihyaline with a narrow fuscous shade along termen and on the veins near their apices.

Alar expanse, 37 mm.

Genitalia (figs. 75–75a) similar to those of *insignatella* but with sclerotized ventral plate in ductus bursae at genital opening smaller.

Type.—In United States National Museum.

Type locality.—Oaxaca, Mexico.

Food plant.—Unknown.

Distribution.—Mexico: *Oaxaca*, Salina Cruz (Sept.).

Eight specimens examined.

Remarks.—This species may be distinguished from other species of *Cactobrosis* by the strong luteous (pale clay) shade on the fore wing and the serrate-fasciculate male antenna.

4. CACTOBROSIS INSIGNATELLA Dyar

PLATE 43, FIGURE 76

Cactobrosis insignatella Dyar, Proc. U. S. Nat. Mus., vol. 47, p. 407, 1915; Proc. Ent. Soc. Washington, vol. 30, p. 136, 1928.

Male.—Unknown.

Female.—Palpi, head, thorax, and fore wing of a soft, nearly uniform grayish fuscous (with a more brownish than slate-gray tint). Fore wing without discal spot or transverse dark markings; costa at base very slightly paler than ground color of wing, concolorous with collar of thorax; an obscure pale shade on midcosta and the faintest indication of a pale subterminal line, the latter broadly angulate at middle; some faint dark shading on the veins from cell to termen and a row of small, dark dots along termen near the vein ends. Hind wing white, semihyaline, with a pale fuscous line along termen; cilia white with a narrow, pale fuscous, subbasal line.

Alar expanse, 37–40 mm.

Genitalia (fig. 76) with the dorsal plates in ductus bursae at genital opening strongly sclerotized; ventral plate at opening slightly larger than in any of the other species.

Type.—In United States National Museum.

Type locality.—Oaxaca, Mexico.

Food plant.—Unknown.

Remarks.—Known only from the female type and paratype from the type locality. These specimens resemble suffused specimens of *fernaldialis* and *longipennella* except that the latter are more slate colored. The slight genitalic differences seem to indicate that *insignatella* is a good species and not a mere color form.

5. CACTOBROSIS STRIGALIS (Barnes and McDunnough)

PLATES 35, 44, 51; FIGURES 39–39c, 77, 138–138a, 139–139a

Euzophera strigalis BARNES and MCDUNNOUGH, Can. Ent., vol. 44, p. 127, 1912; Contr. Nat. Hist. Lepid. North America, vol. 1, no. 4, pl. 1, fig. 14, 1912.

Cactobrosis strigalis (BARNES and MCDUNNOUGH), Check list of the Lepidoptera of Boreal America, no. 5697, 1917.—DYAR, Insecutor Inscitiae Menstruus, vol. 13, p. 224, 1925; Proc. Ent. Soc. Washington, vol. 30, p. 136, 1928.

Male.—Antenna strongly serrate. Palpi, head, thorax, and fore wing grayish fuscous sprinkled with whitish (the ends of the scales white) making the ground color a pale slate-gray. Fore wing with the veins outlined in black, the strongest black line being that along upper vein of cell and vein 6; transverse lines and discal mark absent; no dots along termen. Hind wing white, semihyaline, with a faint fuscous shade bordering costa, and a fine fuscous line along termen for a short distance from apex. Tufts on eighth abdominal segment weak.

Alar expanse, 30–43 mm.

Genitalia (figs. 39–39c) with vinculum moderately long, but considerably shorter than in other species of *Cactobrosis;* aedeagus also shorter.

Female.—Similar to the male in color and markings except that hind wing is more or less suffused with smoky fuscous beyond the base, especially along the veins and termen.

Alar expanse, 33–44 mm.

Genitalia (fig. 77) with sclerotized plates on dorsal wall of ductus bursae behind the genital opening well developed, but with opposing ventral sclerotized plate absent, replaced by minute scobinations; ductus bursae shorter than in other *Cactobrosis* species; bursa copulatrix not entirely smooth, having a few weak scobinations toward ductus.

Type.—In United States National Museum.

Type locality.—Eureka, Utah.

Food plants.—Echinocereus rigidissimus (Engelmann), *E. pectinatus* (Scheidweiler), and probably a number of other species of *Echinocereus.*

Distribution.—UNITED STATES: *Utah*, Eureka (Aug., Sept.), Dividend (Sept.); *California*, San Gorgonio Pass (July); *Arizona*, Tucson (Apr., July), *Texas*, Brewster County (July, Aug.), Alpine (Apr.). MEXICO, Mexico City (National University, male reared from *E. pectinatus*, June 3, 1931).

Eighteen specimens examined.

Remarks.—In a number of respects (its shorter vinculum and ductus bursae, its weak abdominal tufts, and its partially scobinate bursa copulatrix) this species fits badly into *Cactobrosis.* Eventually it may need a separate generic designation; but this had better be postponed until the life histories of the other species of *Cactobrosis* are more fully known.

The fore wing markings of *strigalis* resemble those of *Eremberga leuconips* (Dyar). The latter, however, is easily distinguished by its squamous maxillary palpi.

18. Genus ZOPHODIA Hübner

Zophodia HÜBNER, Verzeichniss bekannter Schmettlinge [sic], p. 370, [1825].—RAGONOT, Ent. Monthly Mag., vol. 22, p. 19, 1885.—HULST, Trans. Amer. Ent. Soc. vol. 17, p. 172, 1890.—HAMPSON, Mémoires sur les Lépidoptères, vol. 8, p. 18, 1901.—SPULER, Die Schmetterlinge Europas, vol. 2, p. 207, 1910.—DYAR, Insecutor Inscitiae Menstruus, vol. 13, p. 220, 1925. (Genotype: *Tinea convolutella* Hübner.)

Dakruma GROTE, Bull. U. S. Geol. and Geogr. Surv. Terr., vol. 4, p. 702, 1878. (Genotype: *Dakruma turbatella* Grote.)

Antenna of male pubescent and with a series of modified, papilla-like setae on the inner sides of several basal segments of the shaft; of female simple and very shortly pubescent. Labial palpus oblique in the male, porrect in the female. Maxillary palpus filiform. Hind wing with veins 7 and 8 anastomosing beyond the cell; 3 and 5 con-

nate (in occasional specimens very shortly stalked). Eighth abdominal segment with a pair of weak ventrolateral hair tufts.

Male genitalia with apical process of gnathos bifid, large; apex of harpe evenly rounded; vinculum long; anellus with base of plate narrowly sclerotized, arms moderately long, slender, slightly twisted; aedeagus moderately long and stout; penis partially ribbed and pubescent.

Female genitalia with a small weak signum developed as a plate with an inwardly projecting flange; bursa copulatrix small, minutely and very weakly scobinate; ductus bursae minutely scobinate, with two rather large, sclerotized, dorsal plates at genital opening; ductus seminalis from bursa near signum.

Larva white or green, faintly striped longitudinally but without cross bands or conspicuous spots; with two setae in group VII on abdominal segments 7 and 8.

The larvae are solitary feeders in the fruits of gooseberry and currant.

Eggs laid singly.

Remarks.—This genus is close to *Cactobrosis* but is not one of the cactus-feeding group. I treat it here because so many cactus phycitids have been referred to it at one time or another and because in genitalic characters it (with some species now listed under *Laetilia* and *Euzophera*) resembles more closely the cactus feeders than any other group in the Phycitinae.

As here defined the genus is limited to its type species. Its distribution is central and southern Europe, the northern part of the United States, and southern Canada.

1. ZOPHODIA CONVOLUTELLA (Hübner)

PLATES 34, 44, 51; FIGURES 36–36e, 78–78c, 132–132a, 133–133a

Tinea convolutella HÜBNER, Sammlung europäischer Schmetterlinge, Horde VIII, Tineae, fig. 34, 1796.

Tinea grossulariella HÜBNER, Geschichte europäischer Schmetterlinge, Tineae II, C.a.b., fig. 2.a.b.c., [1807–1809] (larva).

Phycis grossulariella (Hübner) ZINCKEN, Magazin der Entomologie, vol. 3, p. 144, 1818.—TREITSCHKE, Die Schmetterlinge von Europa, vol. 9, pt. 1, p. 172, 1832; vol. 10, pt. 3, p. 275, 1835.—DUPONCHEL, Histoire naturelle des Lépidoptères, vol. 10, p. 206, pl. 279, fig. 9, 1836.

Zophodia grossularialis HÜBNER, Verzeichniss bekannter Schmettlinge [sic], p. 370, [1825]. (Emended spelling for *grossulariella* and to replace *convolutella*.)

Zophodia convolutella (HÜBNER), Verzeichniss bekannter Schmettlinge [sic], p. 370, [1825].—VON HEINEMANN, Schmetterlinge Deutschlands und der Schweiz, Abt. 2, vol. 1, no. 2, p. 190, 1865.—RAGONOT, Ent. Monthly Mag., vol. 22, p. 19, 1885.—HAMPSON, Mémoires sur les Lépidoptères, vol. 8, p. 20, 1901.—STAUDINGER and REBEL, Catalog der Lepidopteren des palaearctischen

Faunengebietes, vol. 2, p. 25, 1901.—Spuler, Die Schmetterlinge Europas, vol. 2, p. 207, 1910.

Myelois (Zophodia) convolutella (Hübner) Zeller, Isis von Oken, 1839, p. 178; 1848, p. 679.

Homoeosoma convolutella (Hübner) Herrich-Schäffer, Systematische Bearbeitung der Schmetterlinge von Europa, vol. 4, p. 107, 1849.

Pempelia grossulariae Riley, 1st Ann. Rept. Ins. Missouri, p. 140, 1869; Papilio, vol. 1, p. 108, 1881 (suggests synonymy with *convolutella*).—Packard, Guide to the study of insects, p. 331, 1869.

Dakruma turbatella Grote, Bull. U. S. Geol. and Geogr. Surv. Terr., vol. 4, pp. 702, 703, 1878; North Amer. Ent., vol. 1, p. 11, 1879.

Myelois convolutella (Hübner) Packard, Guide to the study of insects (ed. 7), p. 331, 1880.

Dakruma grossulariae (Riley) Grote, North Amer. Ent., vol. 1, p. 68, 1880.

Dakruma convolutella (Hübner) Grote, New check list of North American moths, p. 55, 1882. (Gives *grossulariae* and *turbatella* as synonyms.)

Zophodia grossulariae (Riley) Hulst, Trans. Amer. Ent. Soc., vol. 17, p. 173, 1890; U. S. Nat. Mus. Bull. 52, p. 429, 1903.—Hampson, Mémoires sur les Lépidoptères, vol. 8, p. 21, 1901.—Dyar, Proc. Ent. Soc. Washington, vol. 7, p. 37, 1905; Insecutor Inscitiae Menstruus, vol. 13, p. 221, 1925.—Barnes and McDunnough, Check list of the Lepidoptera of Boreal America, no. 5705, 1917.—Pack, Utah Agr. Exp. Stat. Bull. 216, pp. 1–12, 1930.

Euzophera franconiella Hulst, Trans. Amer. Ent. Soc., vol. 17, p. 177, 1890.—Hampson, Mémoires sur les Lépidoptères, vol. 8, p. 61, 1901.

Zophodia bella Hulst, Can. Ent., vol. 24, p. 61, 1892.—Dyar, Proc. Ent. Soc. Washington, vol. 6, p. 228, 1904.

Zophodia franconiella (Hulst) Barnes and McDunnough, Check list of the Lepidoptera of Boreal America, no. 5706, 1917.

Zophodia grossulariae franconiella (Hulst) Dyar, Insecutor Inscitiae Menstruus, vol. 13, p. 221, 1925.

Zophodia grossulariae ihouna Dyar, Insecutor Inscitiae Menstruus, vol. 13, p. 221, 1925. (New synonymy.)

Zophodia grossulariae dilativitta Dyar, Insecutor Inscitiae Menstruus, vol. 13, p. 222, 1925. (New synonymy.)

Zophodia grossulariae magnificans Dyar, Insecutor Inscitiae Menstruus, vol. 13, p. 222, 1925. (New synonymy.)

Male.—Palpi, head, thorax, and fore wing fuscous dusted with white, the white color strongest in central costal area of fore wing, the general color gray. Fore wing with antemedial line outwardly oblique to lower vein of cell and notched between cell and inner margin, white, bordered outwardly by a more or less extended black shade; subterminal line oblique, slightly dentate and sinuate, white, bordered inwardly by a black line and outwardly by a narrow black line for a short distance from costa; the fold and veins at extreme base of wing and in area beyond subterminal line faintly outlined in black; discal mark at end of cell black, curved, rarely replaced by a pair of dots; a row of black dots along termen between the vein ends. Hind wing pale smoky white with a narrow dark line along termen.

Alar expanse, 25–35 mm.

Genitalia (figs. 36–36d) drawn from slide of European specimen. American examples are identical in all details. Vinculum with lateral margins broadly and shallowly excavate, posterior margin straight.

Female.—Color and markings as in the male, except hind wings slightly darker.

Alar expanse, 26–35 mm.

Genitalia (figs. 78–78c) with signum small and weak. The eighth segment collar is subject to considerable variation in the size and shape of the unsclerotized dorsal area. Some variations are shown in figures 78a, 78b, and 78c. These, however, do not conform to the varieties that have been named and can be found in any series from one locality.

Larva.—Body cream-white, becoming bright green toward maturity and just before pupation purplish green; a dusky green, longitudinal, dorsolateral stripe and a fainter, middorsal stripe extend from the prothorax to the tenth abdominal segment.

Types.—No known existing types for *convolutella*, *grossulariella*, or *grossulariae*; Rutgers College collection (*franconiella bella*); British Museum ? (*turbatella*); United States National Museum (*ihouna*, *dilativitta*, *magnificans*).

Type localities.—Germany (*convolutella*, *grossulariella*); Missouri (*grossulariae*); Oldtown, Maine (*turbatella*); Franconia, N. H. (*franconiella*); Massachusetts (*bella*); southern Utah (*ihouna*); San Diego, Calif. (*dilativitta*); Seattle, Wash. (*magnificans*).

Food plants.—*Ribes grossularia* Linnaeus and other *Ribes* species (larva feeding in the fruit).

Distribution.—EUROPE (central and southern). UNITED STATES: *Maine*, Orono; *New Hampshire*, Hampton (May), Durham; *Missouri; Colorado*, Manitou, Denver (Apr.), Fort Collins (Mar., Apr.), *Utah*, Logan ("June"), Beaver Canyon ("VII"); *Oregon; California*, San Diego; *Washington*, Seattle, Bellingham (Apr.). CANADA: *Quebec*, St. Johns County (Apr.), Mount St. Hilaire (May); *Ontario*, Hymers; *Alberta*, Edmonton (May), Bilby (May); *British Columbia*, Kaslo (Apr.), Wellington (Apr.), Alberni (May), Goldstream (May), Vancouver Island (Apr.).

The foregoing localities are for the specimens before me. The species is generally distributed over the northern part of the United States and southern Canada.

Seventy-four specimens examined.

Remarks.—As far back as 1880 Packard identified the gooseberry feeder in America with the European *convolutella*, and Grote (1882) listed *convolutella* with *grossulariae* and *turbatella* as synonyms.

Later writers, however, all treated *grossulariae* as a distinct species, and it so stands at present in our lists and economic literature. I see nothing either in pattern or genitalic structure to distinguish *grossulariae* from *convolutella* even as a geographic race. The supposed western races named by Dyar are nothing but color forms, differing less from typical European or eastern American forms than do many specimens from a single eastern State. His *ihouna* was described from two faded specimens and *dilativitta* from a single fresh and perfect female. His *magnificans*, though larger than most eastern examples, can be matched in any long series of specimens from Europe or eastern Canada.

The species does not feed upon cactus. It is treated here because its genus has been used as a receptacle for many cactus-feeding species and also because it is similar in genitalic structure to the cactus feeders. In this country it is popularly known as the gooseberry fruitworm and has a rather extensive economic literature. Only one of the more recent economic references is quoted, but the foregoing synonymy is complete so far as I can judge, and the principal systematic references are cited.

It is the most important lepidopterous pest of the gooseberry here and abroad and often does serious injury. It also is recorded as an occasional enemy of currants.

There is one generation a year, moths flying from mid-April to early in June. About 10 months are passed in the pupal stage, the insects overwintering as pupae in loose cocoons on the ground under fallen leaves or other rubbish.

EXPLANATION OF PLATES

The drawings for the plates accompanying this paper were made under the author's supervision by Mrs. Eleanor A. Carlin, of the U. S. Bureau of Entomology and Plant Quarantine. The female genitalia and head structures were drawn to smaller scale than the male genitalia.

EXPLANATION OF SYMBOLS APPLIED TO GENITALIA

Male

aGn, Apical process of gnathos.
An, Anellus.
Hp, Harpe.
pkt, Sclerotized pocket in subbasal area of harpe.
Tn, Elements of a divided transtilla.
U, Uncus.
Vm, Vinculum.

Female

Bc, Bursa copulatrix.
Clr, Collar of eighth abdominal segment.
Db, Ductus bursae.
dp, Dorsal plate in ductus bursae at genital opening.
Ds, Ductus seminalis.
Go, Genital opening.
Sn, Signum.
vp, Ventral plate in ductus bursae at genital opening.

PLATE 23

1–1f. *Melitara prodenialis* Walker: 1, Ventral view of male genitalia with aedeagus and one harpe omitted; 1a, dorsal view of uncus and tegumen; 1b, gnathos; 1c, elements of divided transtilla; 1d, anellus; 1e, aedeagus, lateral view; 1f, aedeagus, ventral view.

2–2c. *Melitara dentata* (Grote): 2, Ventral view of male genitalia with aedeagus and one harpe omitted; 2a, elements of transtilla; 2b, anellus; 2c, aedeagus.

PLATE 24

3–3c. *Olycella junctolineella* (Hulst): 3, Ventral view of male genitalia with aedeagus and one harpe omitted (the apical process of gnathos shown bent somewhat to the side); 3a, elements of transtilla; 3b, anellus; 3c, aedeagus.

4. *Olycella junctolineella pectinatella* (Hampson): Gnathos of male genitalia (the apical process shown in full ventral view).

5–5c. *Olyca phryganoides* Walker: 5, Ventral view of male genitalia with aedeagus and one harpe omitted; 5a, elements of transtilla; 5b, anellus; 5c, aedeagus.

PLATE 25

6–6c. *Alberada bidentella* (Dyar): 6, Ventral view of male genitalia with aedeagus omitted; 6a, elements of transtilla; 6b, anellus; 6c, aedeagus.

7–7c. *Alberada parabates* (Dyar): 7, Ventral view of male genitalia with aedeagus and one harpe omitted; 7a, elements of transtilla; 7b, anellus; 7c, aedeagus.

8–8d. *Nanaia substituta*, new species: Ventral view of male genitalia with aedeagus and one harpe omitted; 8a, elements of transtilla; 8b, anellus; 8c, aedeagus; 8d, sternite and tergite of eighth abdominal segment of male.

PLATE 26

9–9c. *Cactoblastis cactorum* (Berg): 9, Ventral view of male genitalia with aedeagus and one harpe omitted; 9a, elements of transtilla; 9b, anellus; 9c, aedeagus.

10. *Cactoblastis doddi*, new species: Gnathos of male genitalia.

11. *Cactoblastis mundelli*, new species: Gnathos of male genitalia.

12–12c. *Cactoblastis bucyrus* Dyar: 12, Ventral view of male genitalia with aedeagus and one harpe omitted; 12a, elements of transtilla; 12b, anellus; 12c, aedeagus.

13–13f. *Cahela ponderosella* (Barnes and McDunnough): 13, Ventral view of male genitalia with aedeagus and one harpe omitted; 13a–c, various modifications of apical process of gnathos; 13d, elements of transtilla; 13e, anellus; 13f, aedeagus.

PLATE 27

14–14c. *Rumatha bihinda* (Dyar): 14, Ventral view of male genitalia with aedeagus and one harpe omitted; 14a, elements of transtilla; 14b, anellus; 14c, aedeagus.

15–15c. *Rumatha polingella* (Dyar): 15, Ventral view of male genitalia with aedeagus and one harpe omitted; 15a, elements of transtilla; 15b, anellus; 15c, aedeagus.

16–16c. *Rumatha glaucatella* (Hulst): 16, Ventral view of male genitalia with aedeagus omitted; 16a, elements of transtilla; 16b, anellus; 16c, aedeagus.

17–17d. *Tucumania tapiacola* Dyar: 17, Ventral view of male genitalia with aedeagus omitted; 17a, elements of transtilla; 17b, anellus; 17c, aedeagus; 17d, sternite and tergite of eighth abdominal segment of male.

PLATE 28

18–18c. *Yosemitia fieldiella* (Dyar): 18, Ventral view of male genitalia with aedeagus omitted; 18a, elements of transtilla; 18b, anellus; 18c, aedeagus.

19–19c. *Yosemitia didactica* Dyar: 19, Ventral view of male genitalia with aedeagus omitted; 19a, elements of transtilla; 19b, anellus; 19c, aedeagus.

20–20c. *Yosemitia longipennella* (Hulst): 20, Ventral view of male genitalia with aedeagus omitted; 20a, elements of transtilla; 20b, anellus; 20c, aedeagus.

21–21d. *Yosemitia graciella* (Hulst): 21, Ventral view of male genitalia with aedeagus omitted; 21a, elements of transtilla; 21b, anellus; 21c, aedeagus; 21d, sternite and tergite of eighth abdominal segment of male.

PLATE 29

22–22c. *Eremberga leuconips* (Dyar): 22, Ventral view of male genitalia with aedeagus and one harpe omitted; 22a, elements of transtilla; 22b, anellus; 22c, aedeagus.

23–23c. *Eremberga insignis*, new species: 23, Ventral view of male genitalia with aedeagus and one harpe omitted; 23a, elements of transtilla; 23b, anellus; 23c, aedeagus.

24–24c. *Eremberga creabates* (Dyar): Ventral view of male genitalia with aedeagus and one harpe omitted; 24a, elements of transtilla; 24b, anellus; 24c, aedeagus.

PLATE 30

25–25c. *Parolyca asthenosoma* (Dyar): 25, Ventral view of male genitalia with aedeagus and one harpe omitted; 25a, elements of transtilla; 25b, anellus; 25c, aedeagus.

26–26c. *Salambona analamprella* (Dyar): 26, Ventral view of male genitalia with aedeagus and one harpe omitted; 26a, elements of transtilla; 26b, anellus; 26c, aedeagus.

27–27d. *Sigelgaita transilis*, new species: 27, Ventral view of male genitalia with aedeagus and one harpe omitted; 27a, elements of transtilla; 27b, anellus; 27c, aedeagus; 27d, eighth abdominal segment of male, showing hair tufts.

PLATE 31

28–28c. *Sigelgaita chilensis*, new species: 28, Ventral view of male genitalia with aedeagus and one harpe omitted; 28a, elements of transtilla; 28b, anellus; 28c, aedeagus.

29–29d. *Amalafrida leithella* (Dyar): 29, Ventral view of male genitalia with aedeagus and one harpe omitted; 29a, elements of transtilla; 29b, anellus; 29c, aedeagus; 29d, eighth abdominal segment of male, showing hair tufts.

PLATE 32

30–30e. *Ozamia lucidalis* (Walker): 30, Ventral view of male genitalia with aedeagus and one harpe omitted (apical process of gnathos partly bent); 30a, gnathos (full ventral view); 30b, elements of transtilla; 30c, anellus; 30d, aedeagus; 30e, tufts of eighth abdominal segment of male.

31–31c. *Ozamia odiosella fuscomaculella* (Wright): 31, Ventral view of male genitalia with aedeagus and one harpe omitted; 31a, elements of transtilla; 31b, anellus; 31c, aedeagus.

32–32c. *Ozamia punicans*, new species: 32, Ventral view of male genitalia with aedeagus and one harpe omitted; 32a, elements of transtilla; 32b, anellus; 32c, aedeagus.

PLATE 33

33–33d. *Ozamia odiosella* (Hulst) (=*clarefacta* Dyar, type): 33, Ventral view of male genitalia with aedeagus and one harpe omitted; 33a, elements of transtilla; 33b, anellus; 33c, aedeagus; 33d, hair tufts on eighth abdominal segment of male.

34. *Ozamia odiosella* (Hulst), Texas specimen: Side view of male genitalia with one harpe omitted.

35–35d. *Ozamia hemilutella* Dyar: 35, Ventral view of male genitalia with aedeagus and one harpe omitted; 35a, elements of transtilla; 35b, anellus; 35c, aedeagus; 35d, hair tufts on eighth abdominal segment of male.

PLATE 34

36–36e. *Zophodia convolutella* (Hübner): 36, Ventral view of male genitalia with aedeagus omitted (apical process of gnathos bent to one side); 36a, ventral view of apical process of gnathos; 36b, elements of transtilla; 36c, anellus; 36d, aedeagus; 36e, tufts of eighth abdominal segment of male.

37–37e. *Cactobrosis longipennella* (Hampson) (=*elongatella* Hampson): 37, Ventral view of male genitalia with aedeagus omitted; 37a, dorsal view of uncus and tegumen; 37b, elements of transtilla; 37c, anellus; 37d, aedeagus; 37e, tufts of eighth abdominal segment of male.

PLATE 35

38–38d. *Cactobrosis maculifera* Dyar: 38, Ventral view of male genitalia with aedeagus and one harpe omitted; 38a, dorsal view of denuded harpe showing transverse creases; 38b, elements of transtilla; 38c, anellus; 38d, aedeagus.

39–39c. *Cactobrosis strigalis* (Barnes and McDunnough): 39, Ventral view of male genitalia with aedeagus and one harpe omitted; 39a, elements of transtilla; 39b, anellus; 39c, aedeagus.

PLATE 36

40. *Melitara dentata* (Grote): Female genitalia.

41–41a. *Melitara prodenialis* Walker: 41, Female genitalia; 41a, dorsal view of eighth segment collar.

42–42a. *Olycella junctolineella* (Hulst): 42, Female genitalia; 42a, collar of eighth abdominal segment, dorsal view.

43. *Olycella subumbrella* (Dyar): Collar of eighth abdominal segment, dorsal view.

PLATE 37

44–44a. *Olyca phrygamoides* Walker: 44, Female genitalia; 44a, collar of eighth abdominal segment, dorsal view.

45–45a. *Alberada parabates* (Dyar): 45, Female genitalia; 45a, collar of eighth abdominal segment, dorsal view.

46. *Alberada bidentella* (Dyar): Female genitalia.

47. *Alberada holochlora* (Dyar): Female genitalia.

PLATE 38

48–48a. *Cactoblastis cactorum* (Berg): 48, Female genitalia; 48a, collar of eighth abdominal segment, dorsal view.

49–49a. *Cactoblastis doddi*, new species: 49, Female genitalia; 49a, collar of eighth abdominal segment, dorsal view.

50–50b. *Cactoblastis bucyrus* Dyar: 50, Female genitalia; 50a, collar of eighth abdominal segment, dorsal view; 50b, signum, showing extreme of reduction in the species.

51–51a. *Cahela ponderosella* (Barnes and McDunnough): 51, Female genitalia 51a, collar of eighth abdominal segment, dorsal view.

PLATE 39

52. *Rumatha glaucatella* (Hulst): Female genitalia with eighth-segment collar and ovipositor omitted and with signum shown, much enlarged, to the side of bursa.
53. *Rumatha polingella* (Dyar): Female genitalia with eighth-segment collar and ovipositor omitted.
54. *Rumatha bihinda* (Dyar): Female genitalia.
55–55a. *Eremberga leuconips* (Dyar): 55, Female genitalia; 55a, collar of eighth abdominal segment, dorsal view.
56. *Yosemitia* sp.: Female genitalia (see remarks under *Eremberga insignis*, p. 379).

PLATE 40

57. *Yosemitia graciella* (Hulst): Female genitalia (signum shown to the side, much enlarged).
58. *Yosemitia longipennella* (Hulst): Female genitalia with eighth segment collar and ovipositor omitted (signum shown to the side, much enlarged).
59–59a. *Tucumania tapiacola* Dyar: 59, Female genitalia; 59a, collar of eighth abdominal segment, dorsal view.
60. *Tucumania porrecta* Dyar: Female genitalia with eighth-segment collar and ovipositor omitted (signum shown to the side, much enlarged).
61–61a. *Ozamia punicans*, new species: 61, Female genitalia; 61a, collar of eighth abdominal segment, dorsal view.

PLATE 41

62–62a. *Ozamia stigmaferella* (Dyar): 62, Female genitalia; 62a, collar of eighth abdominal segment, dorsal view.
63–63a. *Ozamia thalassophila* Dyar: 63, Female genitalia; 63a, collar of eighth abdominal segment, dorsal view.
64–64a. *Ozamia odiosella* (Hulst): 64, Female genitalia; 64a, collar of eighth abdominal segment, dorsal view.
65–65a. *Ozamia hemilutella* Dyar: 65, Female genitalia; 65a, collar of eighth abdominal segment, dorsal view.
66–66a. *Ozamia lucidalis* (Walker): 66, Female genitalia; 66a, collar of eighth abdominal segment, dorsal view.
67. *Ozamia odiosella fuscomaculella* (Wright): Female genitalia.

PLATE 42

68–68a. *Amalafrida leithella* (Dyar): 68, Female genitalia; 68a, collar of eighth abdominal segment, dorsal view.
69. *Salambona analamprella* (Dyar): Female genitalia.
70–70a. *Sigelgaita chilensis*, new species: 70, Female genitalia; 70a, collar of eighth abdominal segment, dorsal view.
71–71a. *Sigelgaita huanucensis*, new species: 71, Female genitalia; 71a, collar of eighth abdominal segment, dorsal view.
72–72a. *Nanaia substituta*, new species: 72, Female genitalia; 72a, collar of eighth abdominal segment, dorsal view.

PLATE 43

73–73a. *Cactobrosis fernaldialis* (Hulst): 73, Female genitalia; 73a, collar of eighth abdonimal segment, dorsal view.

74–74a. *Cactobrosis longipennella* (Hampson) [=*elongatella* (Hampson)]: 74, Female genitalia; 74a, collar of eighth abdonimal segment, dorsal view.

75–75a. *Cactobrosis maculifera* Dyar: 75, Part of female genitalia showing genital opening and eighth segment collar, ventral view; 75a, collar of eighth abdominal segment, dorsal view.

76. *Cactobrosis insignatella* Dyar: Female genitalia.

PLATE 44

77. *Cactobrosis strigalis* (Barnes and McDunnough): Female genitalia.

78–78c. *Zophodia convolutella* (Hübner): 78, Female genitalia; 78a–c, variations in the collar of eighth abdominal segment, dorsal views.

79. *Yosemitia graciella* (Hulst): Wings, showing venation.

80. *Cactoblastis cactorum* (Berg): Wings, showing venation.

81. *Melitara prodenialis* Walker: Wings, showing venation.

82. *Tucumania tapiacola* Dyar: Wings, showing venation.

PLATE 45

83–83a. *Melitara prodenialis* Walker: 83, Side view of head of male showing palpi; 83a, part of shaft of male antenna.

84. *Melitara prodenialis* Walker: Part of shaft of female antenna.

85–85a. *Melitara dentata* (Grote): 85, Side view of male head; 85a, part of shaft of male antenna.

86–86a. *Melitara dentata* (Grote): 86, Side view of female head; 86a, part of shaft of female antenna.

87–87a. *Olycella nephelepasa* (Dyar): 87, Side view of male head; 87a, part of shaft of male antenna.

88–88a. *Olycella junctolineella* (Hulst): 88, Side view of male head; 88a, part of shaft of male antenna.

89–89a. *Olycella junctolineella* (Hulst): 89, Side view of female head; 89a, part of shaft of female antenna.

PLATE 46

90. *Olyca phryganoides* Walker: Side view of male head.

91. *Olyca phryganoides* Walker: Side view of female head.

92–92a. *Alberada parabates* (Dyar): 92, Side view of male head; 92a, part of shaft of male antenna.

93–93a. *Alberada parabates* (Dyar): 93, Side view of female head; 93a, part of shaft of female antenna.

94–94a. *Alberada holochlora* (Dyar): 94, Side view of female head; 94a, part of shaft of female antenna.

95–95a. *Alberada bidentella* (Dyar): 95, Side view of male head; 95a, part of shaft of male antenna.

96–96a. *Alberada bidentella* (Dyar): 96, Side view of female head; 96a, part of shaft of female antenna.

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PLATE 47

97–97a. *Nanaia substituta*, new species: 97, Side view of male head; 97a, part of shaft of male antenna.
98–98a. *Cactoblastis cactorum* (Berg): 98, Side view of male head; 98a, part of shaft of male antenna.
99. *Cactoblastis cactorum* (Berg): Side view of female head.
100. *Cactoblastis mundelli*, new species: Side view of male head.
101. *Cactoblastis mundelli*, new species: Side view of female head.
102–102a. *Cahela ponderosella* (Barnes and McDunnough): 102, Side view of male head; 102a, part of shaft of male antenna.
103–103a. *Cahela ponderosella* (Barnes and McDunnough): 103, Side view of female head; 103a, part of shaft of female antenna.

PLATE 48

104–104a. *Rumatha glaucatella* (Hulst): 104, Side view of male head; 104a, part of shaft of male antenna.
105–105a. *Rumatha glaucatella* (Hulst): 105, Side view of female head; 105a, part of shaft of female antenna.
106–106a. *Rumatha polingella* (Dyar): 106, Side view of male head; 106a, part of shaft of male antenna.
107–107a. *Rumatha polingella* (Dyar): 107, Side view of female head; 107a, part of shaft of female antenna.
108–108a. *Rumatha bihinda* (Dyar): 108, Side view of male head; 108a, part of shaft of male antenna.
109–109a. *Rumatha bihinda* (Dyar): 109, Side view of female head; 109a, part of shaft of female antenna.
110–110a. *Yosemitia didactica* Dyar: 110, Side view of male head; 110a, part of shaft of male antenna.
111–111a. *Yosemitia graciella* (Hulst): 111, Side view of female head; 111a, part of shaft of female antenna.
112–112a. *Yosemitia longipennella* (Hulst): 112, Side view of male head; 112a, part of shaft of male antenna.
113–113a. *Yosemitia longipennella* (Hulst): 113, Side view of female head; 113a, part of shaft of female antenna.

PLATE 49

114–114a. *Yosemitia fieldiella* (Dyar): 114, Side view of male head; 114a, part of shaft of male antenna.
115–115a. *Yosemitia fieldiella* (Dyar): 115, Side view of female head; 115a, part of shaft of female antenna.
116–116a. *Salambona analamprella* (Dyar): 116, Side view of male head; 116a, part of shaft of male antenna.
117–117a. *Salambona analamprella* (Dyar): 117, Side view of female head; 117a, part of shaft of female antenna.
118–118a. *Eremberga leuconips* (Dyar): 118, Side view of male head; 118a, part of shaft of male antenna.
119–119a. *Eremberga leuconips* (Dyar): 119, Side view of female head; 119a, part of shaft of female antenna.
120–120a. *Eremberga creabates* (Dyar): 120, Side view of male head; 120a, part of shaft of male antenna.
121–121a. *Tucumania tapiacola* Dyar: 121, Side view of male head; 121a, part of shaft of male antenna.
122. *Tucumania tapiacola* Dyar: Side view of female head.
123. *Tucumania porrecta* Dyar: Side view of female head.

124–124a. *Parolyca asthenosoma* (Dyar): 124, Side view of male head; 124a, part of shaft of male antenna.

PLATE 50

125–125a. *Sigelgaita chilensis*, new species: 125, Side view of male head; 125a, part of shaft of male antenna.

126. *Sigelgaita chilensis*, new species; Side view of female head.

127–127c. *Sigelgaita transilis*, new species: 127, Side view of male head; 127a–b, two views of basal segments of male antenna; 127c, three segments from basal part of shaft, greatly enlarged, showing attachment of modified setae to shaft and inner row of pectinations.

128–128c. *Amalafrida leithella* (Dyar): 128, Side view of male head; 128a–b, two views of basal segments of male antenna; 128c, inner pectination from one of basal segments of shaft showing attachment of modified setae (greatly enlarged).

129. *Amalafrida leithella* (Dyar): Side view of female head.

130–130a. *Ozamia odiosella fuscomaculella* (Wright): 130, Side view of male head; 130a, basal segments of male antenna.

131–131a. *Ozamia thalassophila* Dyar: Side view of female head; 131a, part of shaft of female antenna.

PLATE 51

132–132a. *Zophodia convolutella* (Hübner): 132, Side view of male head; 132a, basal segments of male antenna.

133–133a. *Zophodia convolutella* (Hübner): Side view of female head; 133a, part of shaft of female antenna.

134–134c. *Cactobrosis fernaldialis* (Hulst): 134, Side view of male head; 134a, maxillary palpus, greatly enlarged; 134b, part of shaft of male antenna, ventral view; 134c, basal segments of male antenna, lateral view.

135–135a. *Cactobrosis fernaldialis* (Hulst): 135, Side view of female head; 135a, part of shaft of female antenna.

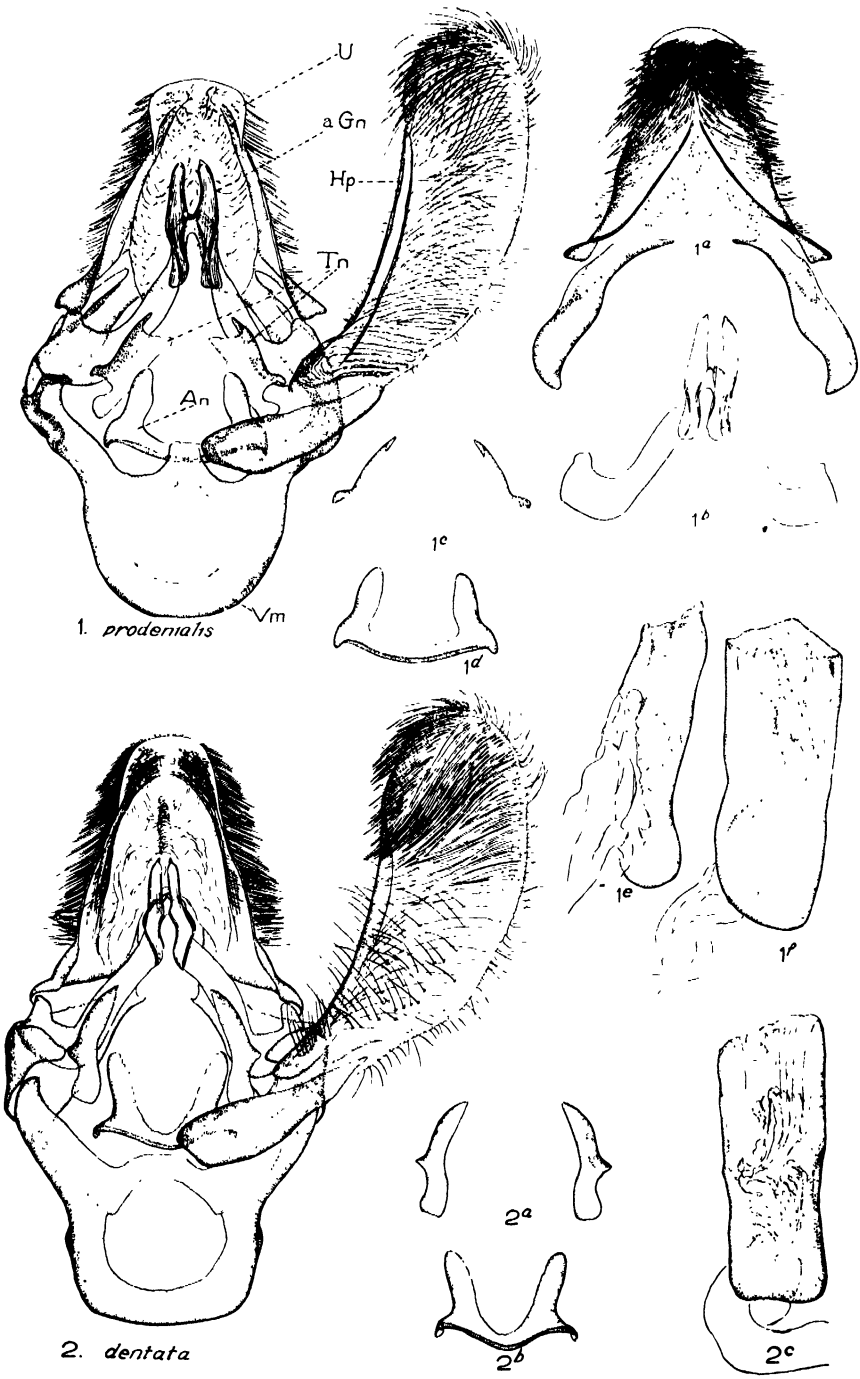
136–136b. *Cactobrosis longipennella* (Hampson): 136, Side view of male head; 136a, part of shaft of male antenna, ventral view; 136b, basal segments of male antenna, lateral view.

137–137a. *Cactobrosis maculifera* Dyar: 137, Part of shaft of male antenna, ventral view; 137a, basal segments of male antenna, lateral view.

138–138a. *Cactobrosis strigalis* (Barnes and McDunnough): 138, Side view of male head; 138a, part of shaft of male antenna, lateral view.

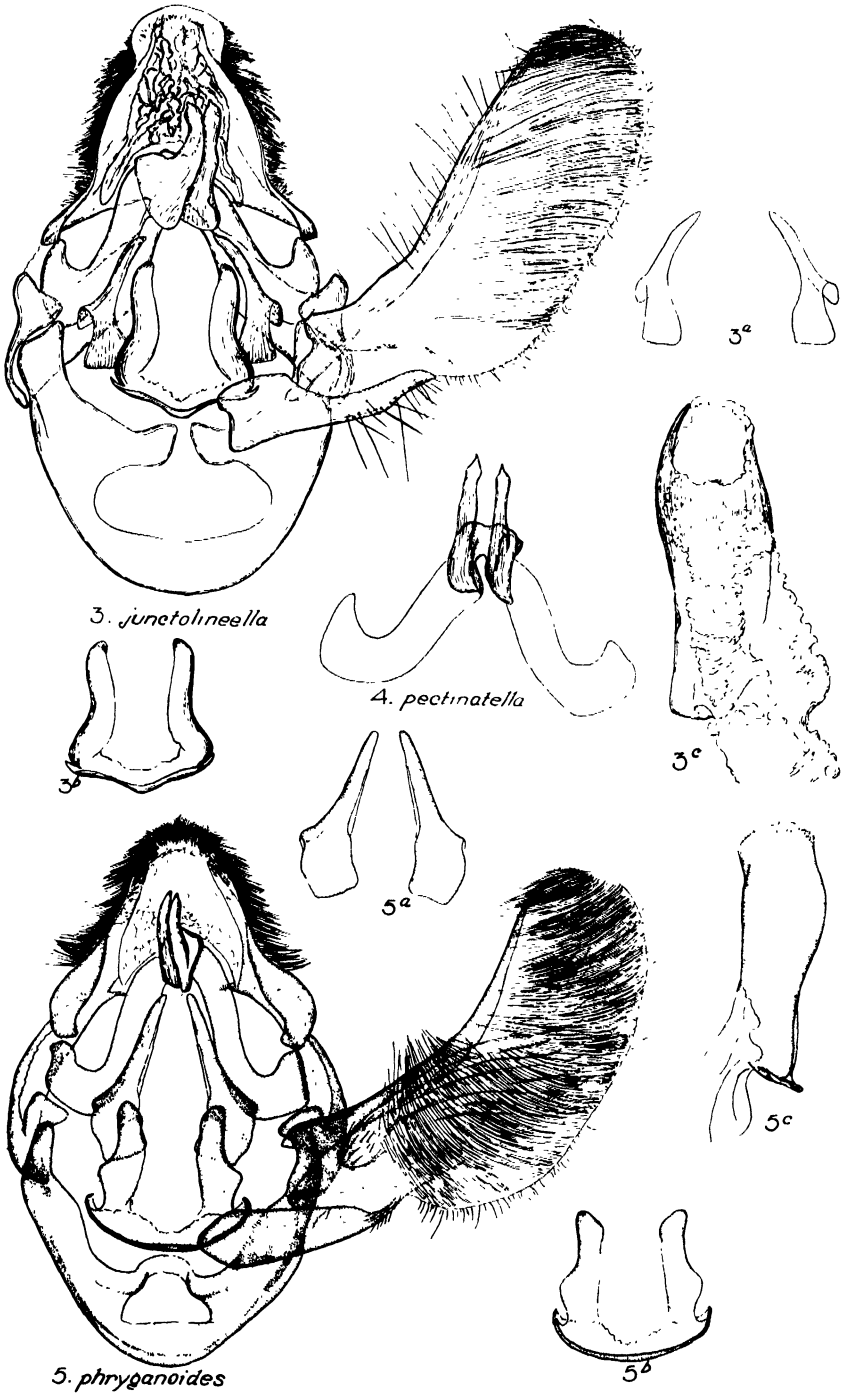
139–139a. *Cactobrosis strigalis* (Barnes and McDunnough): 139, Side view of female head; 139a, part of shaft of female antenna.

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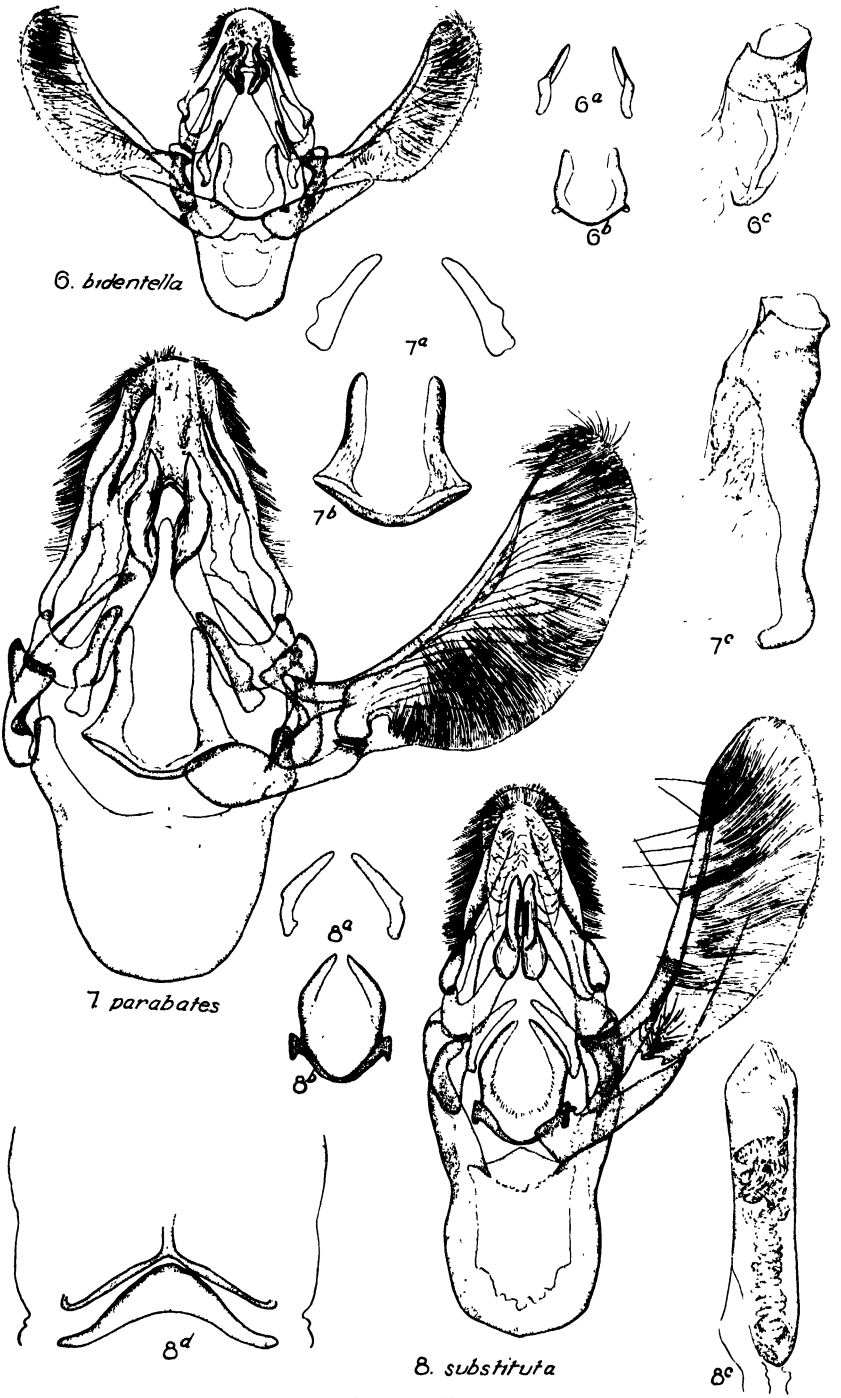
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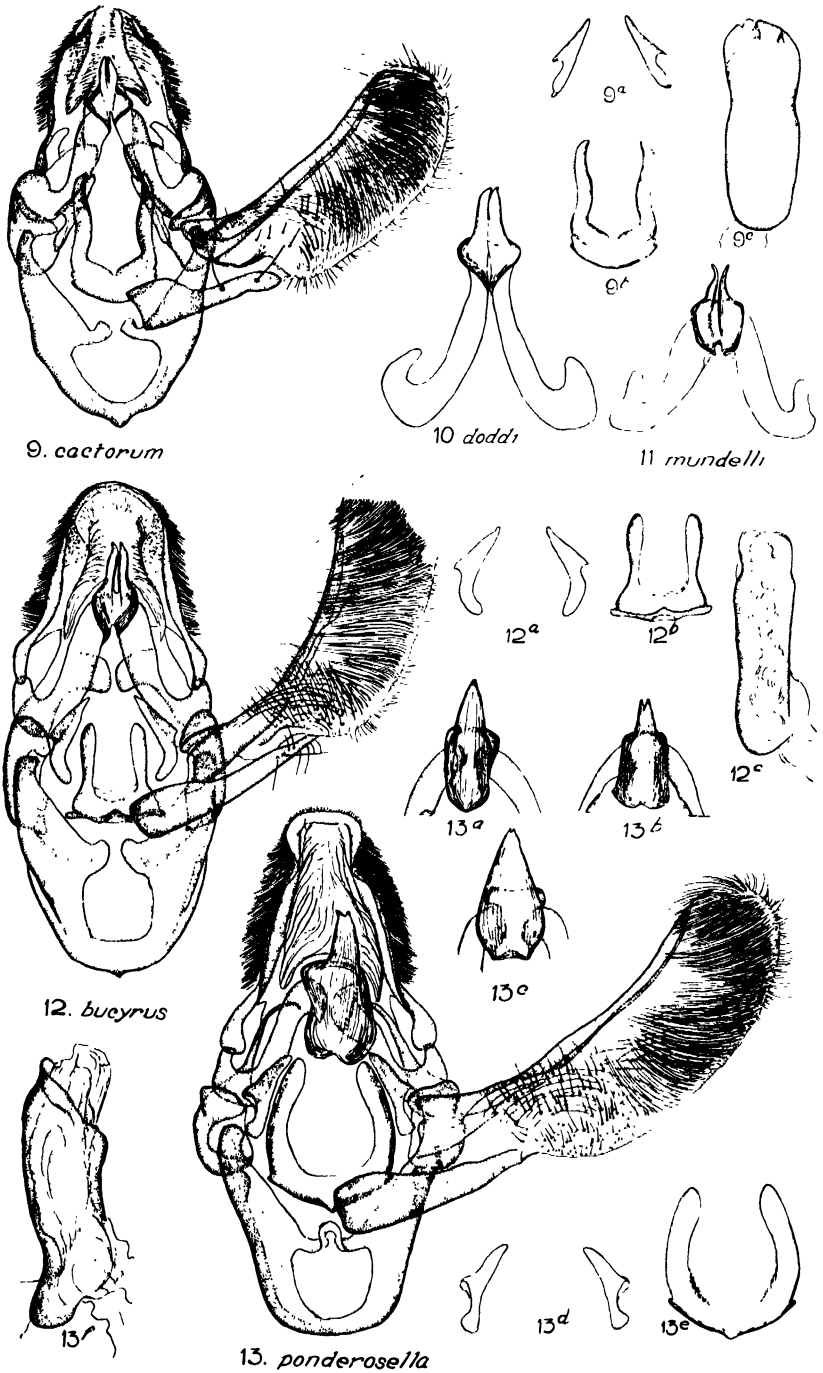
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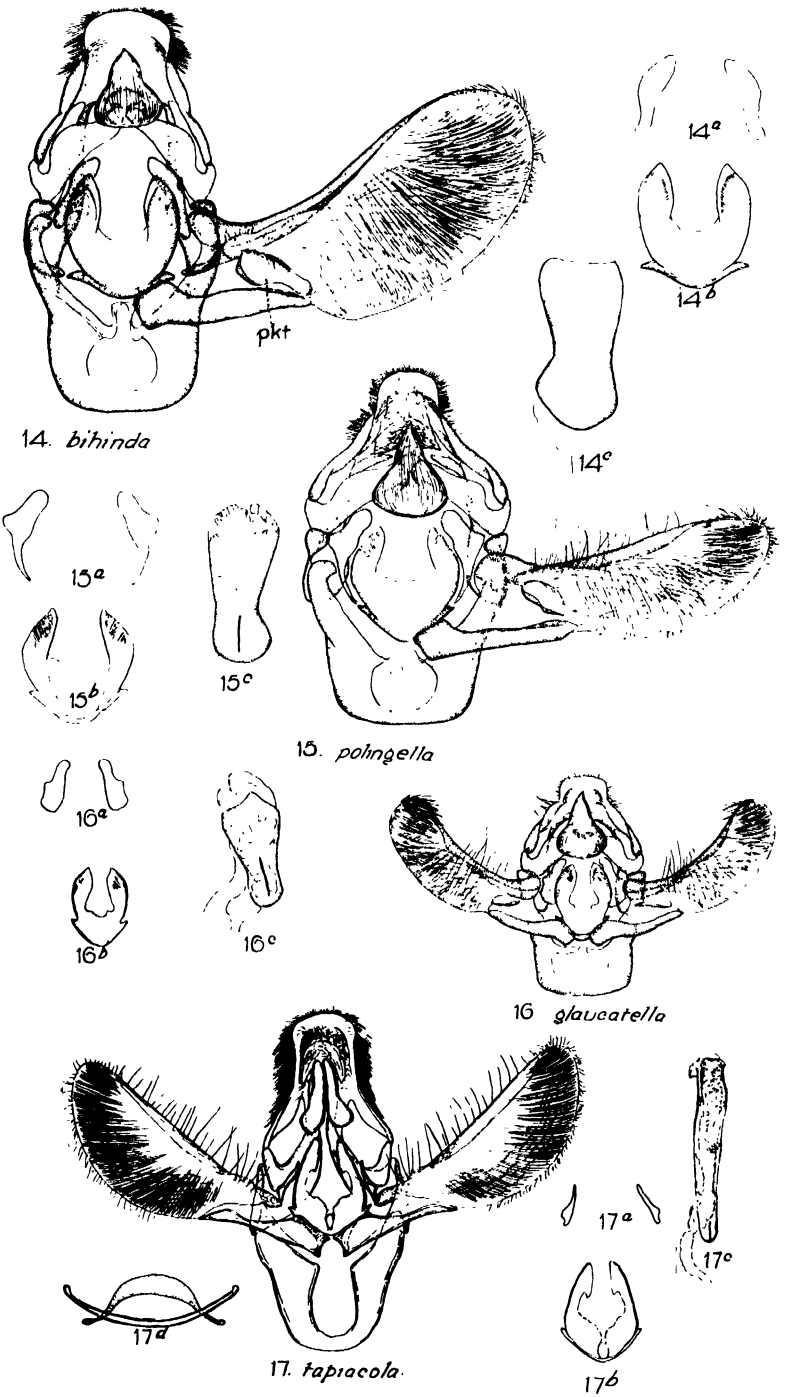
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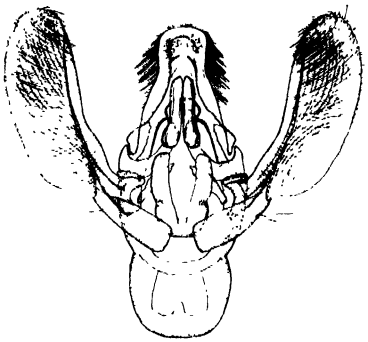
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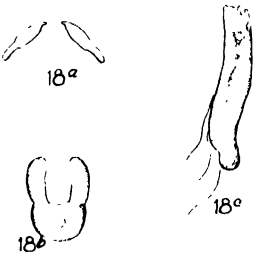


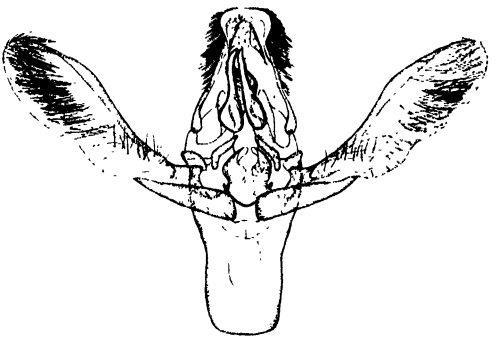
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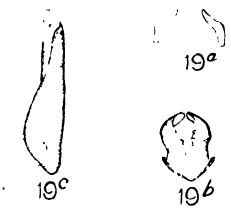


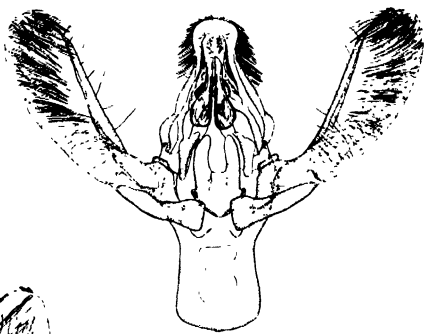
18. *fieldiella*



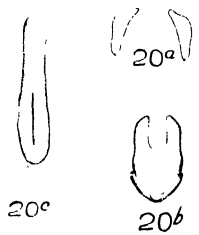


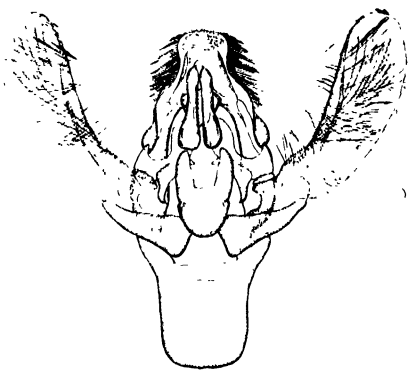
19. *didactica*



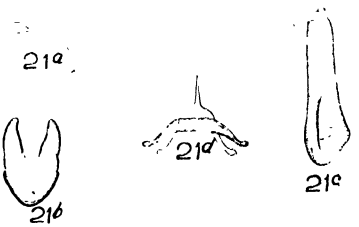


20. *longipennella*



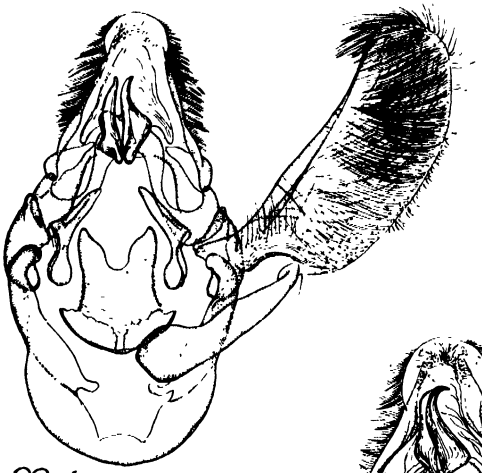


21. *graciella*

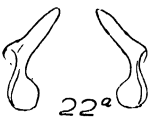


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22 leuconips



22a



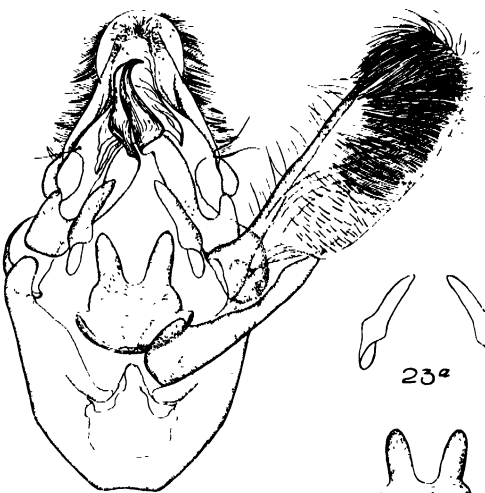
22b



22c



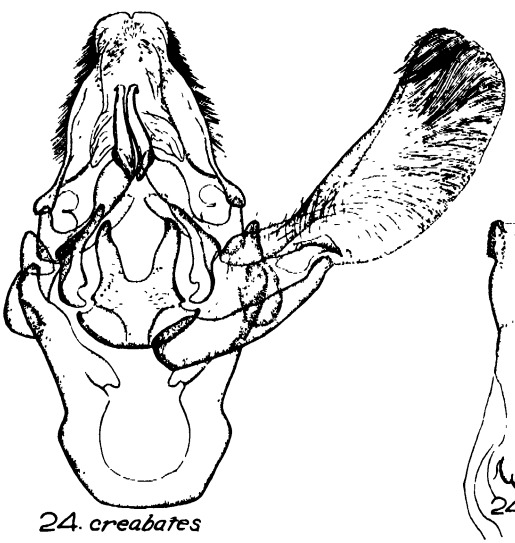
23c



23. insignis

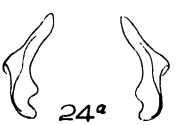
23a

23b

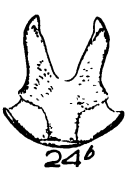


24. creabates

24c



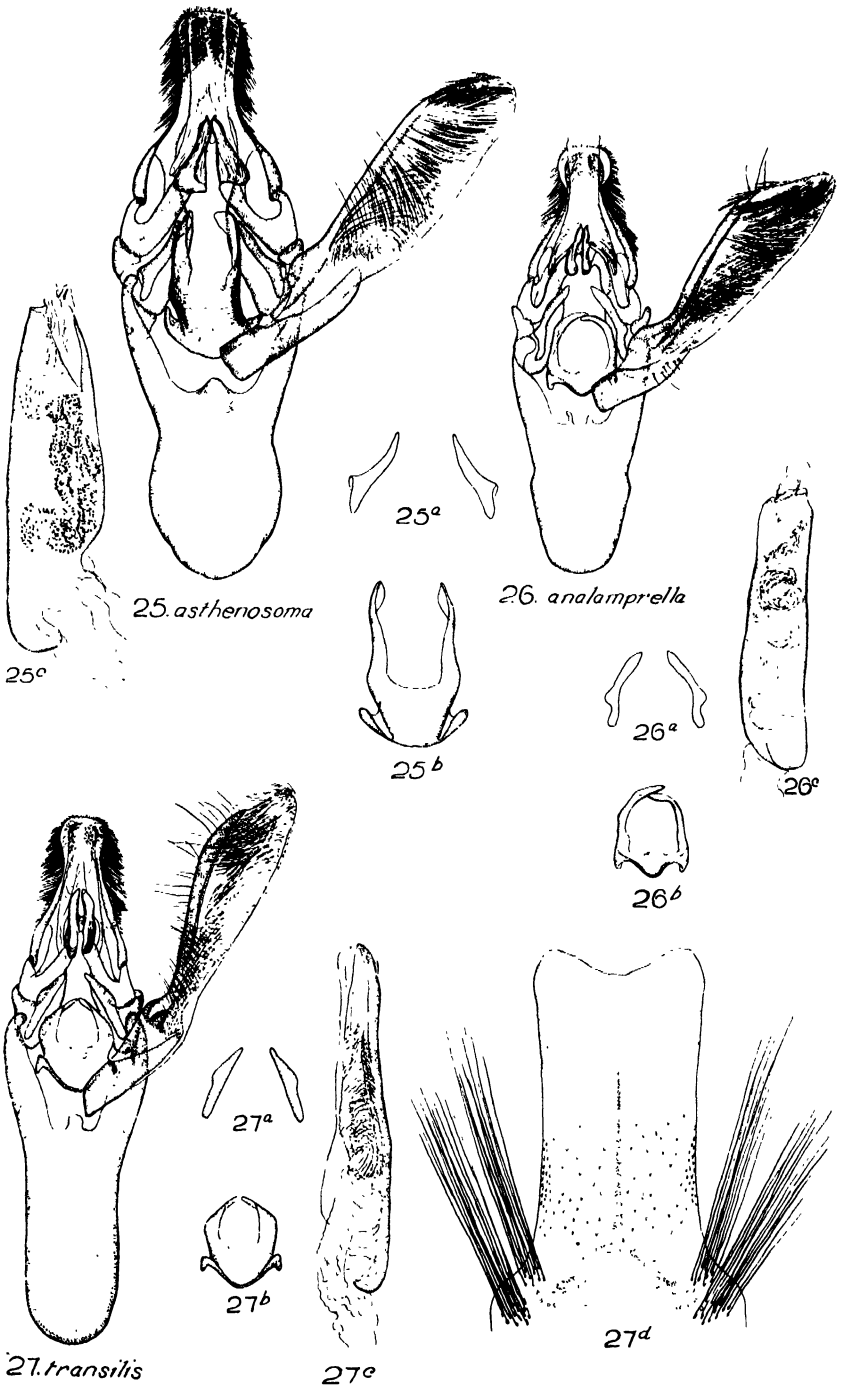
24a



24b

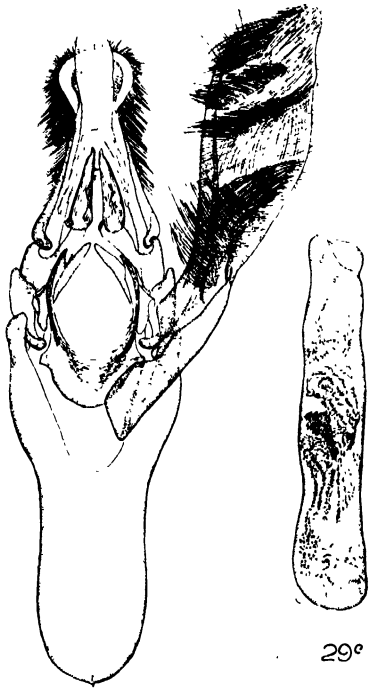
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29. lerthella

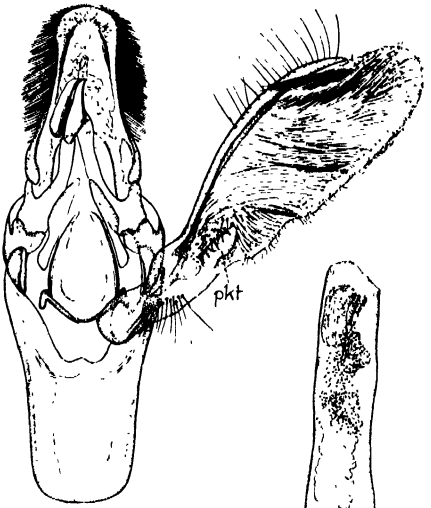
29c



29a



29b

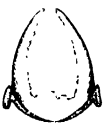


28. chilensis

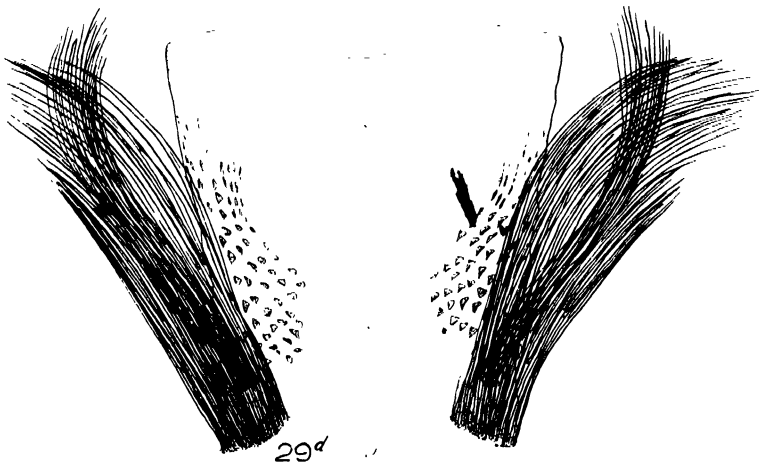
28c



28a



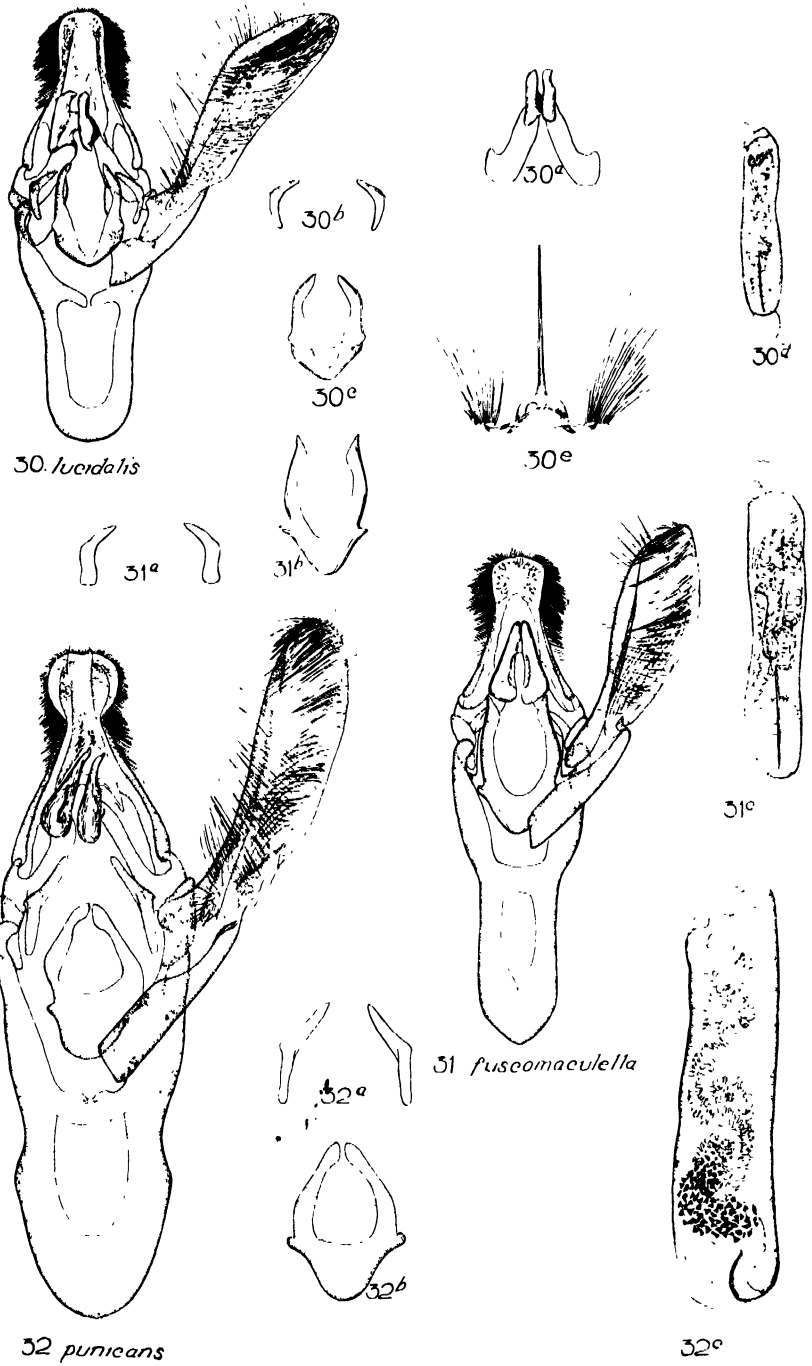
28b



29d

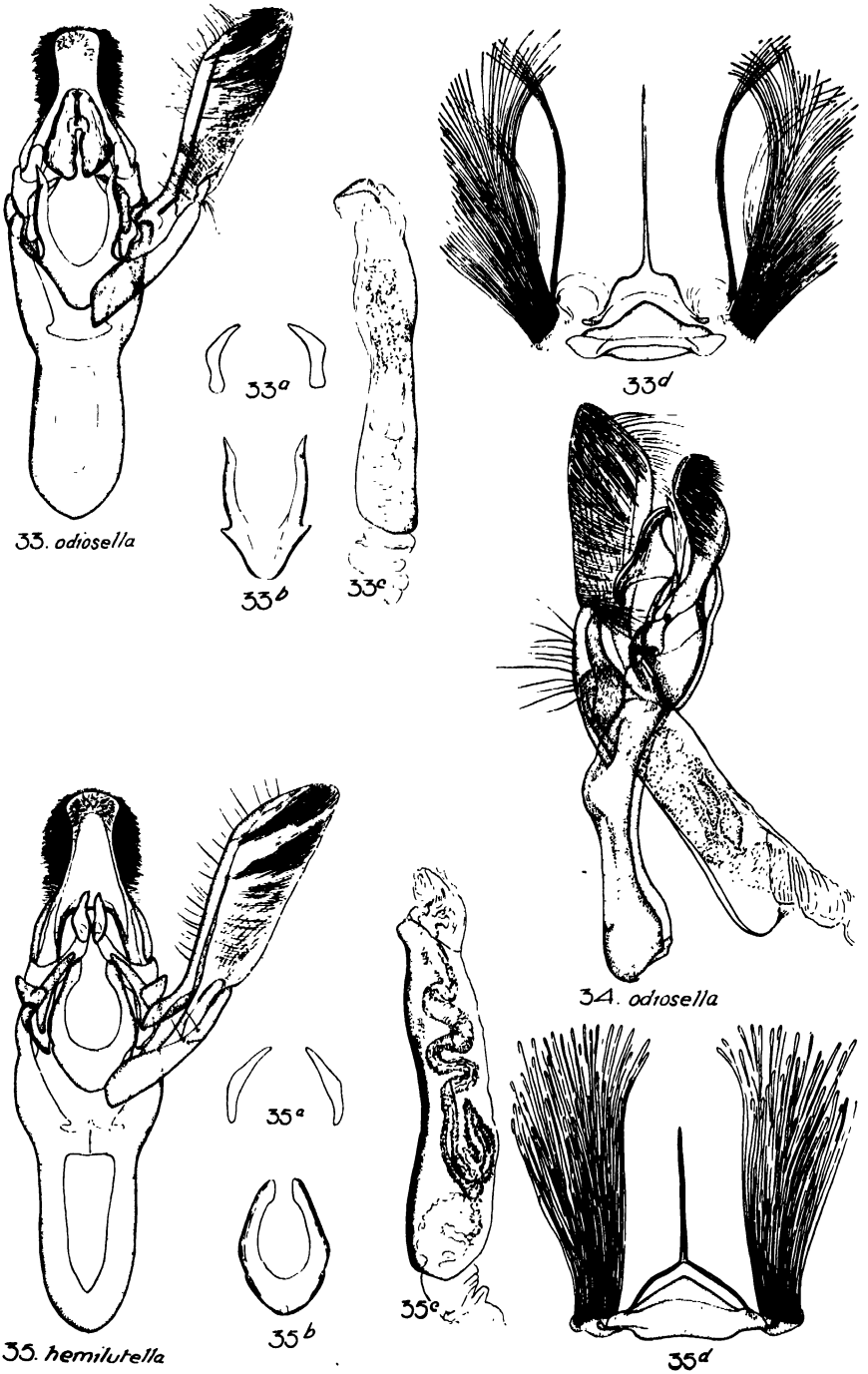
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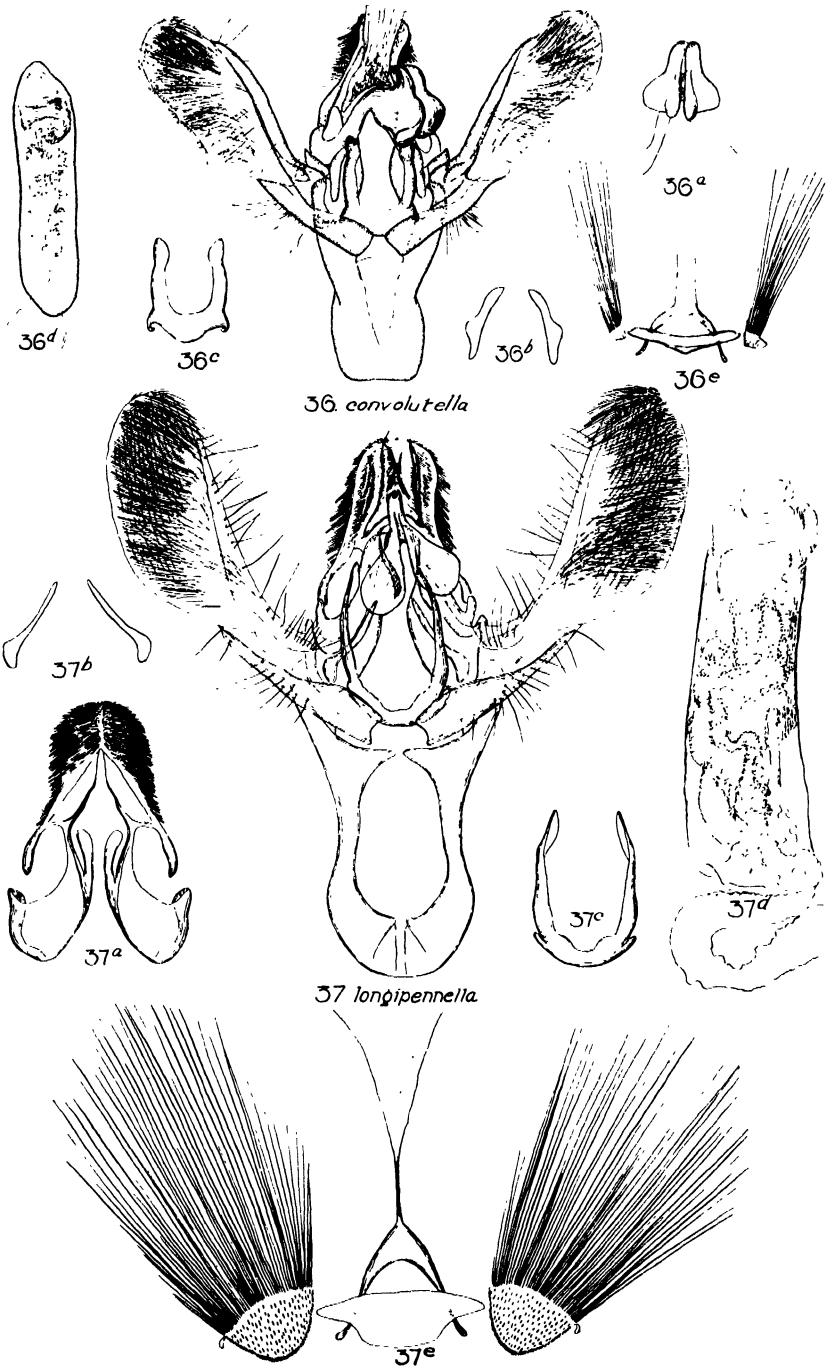
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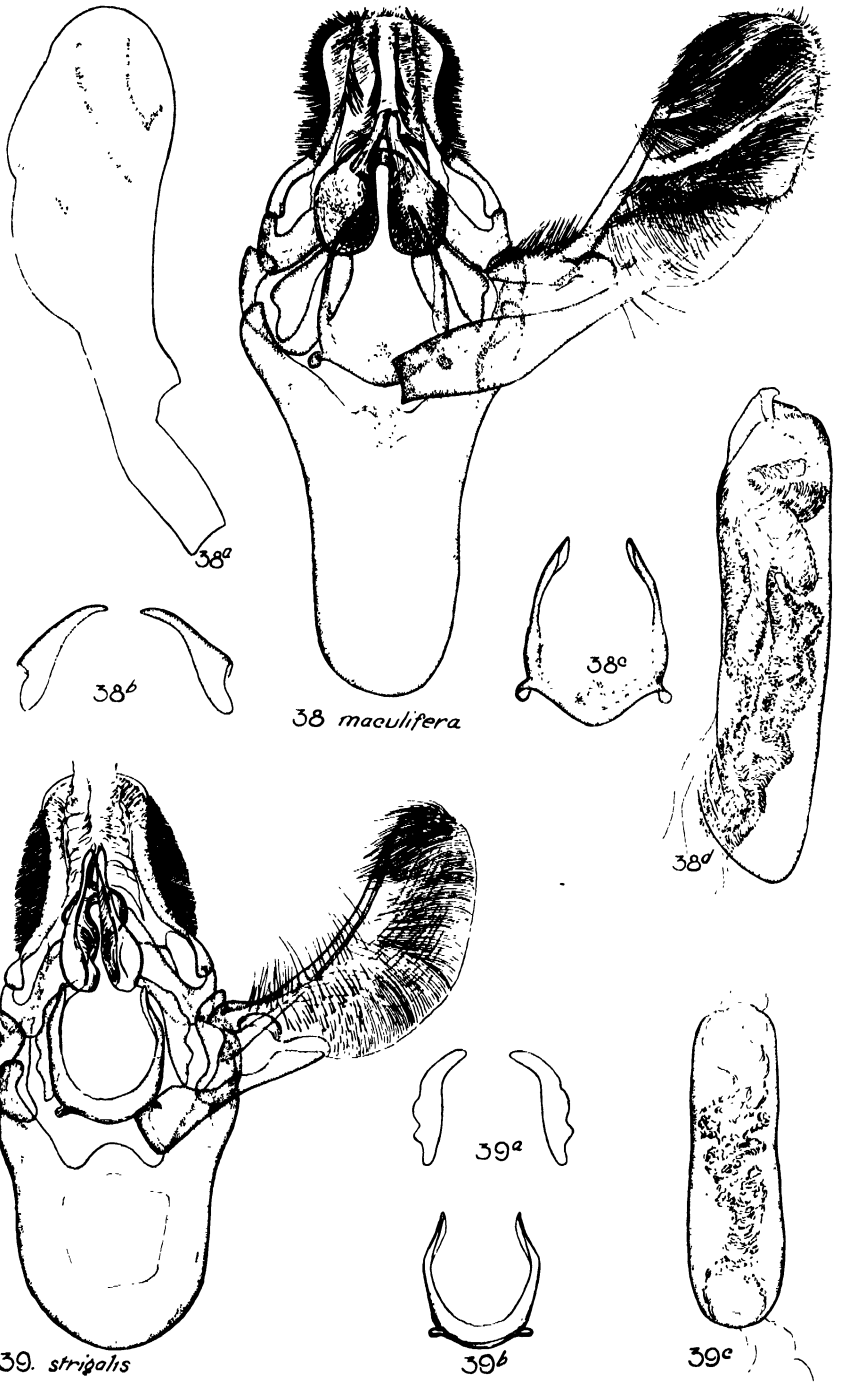
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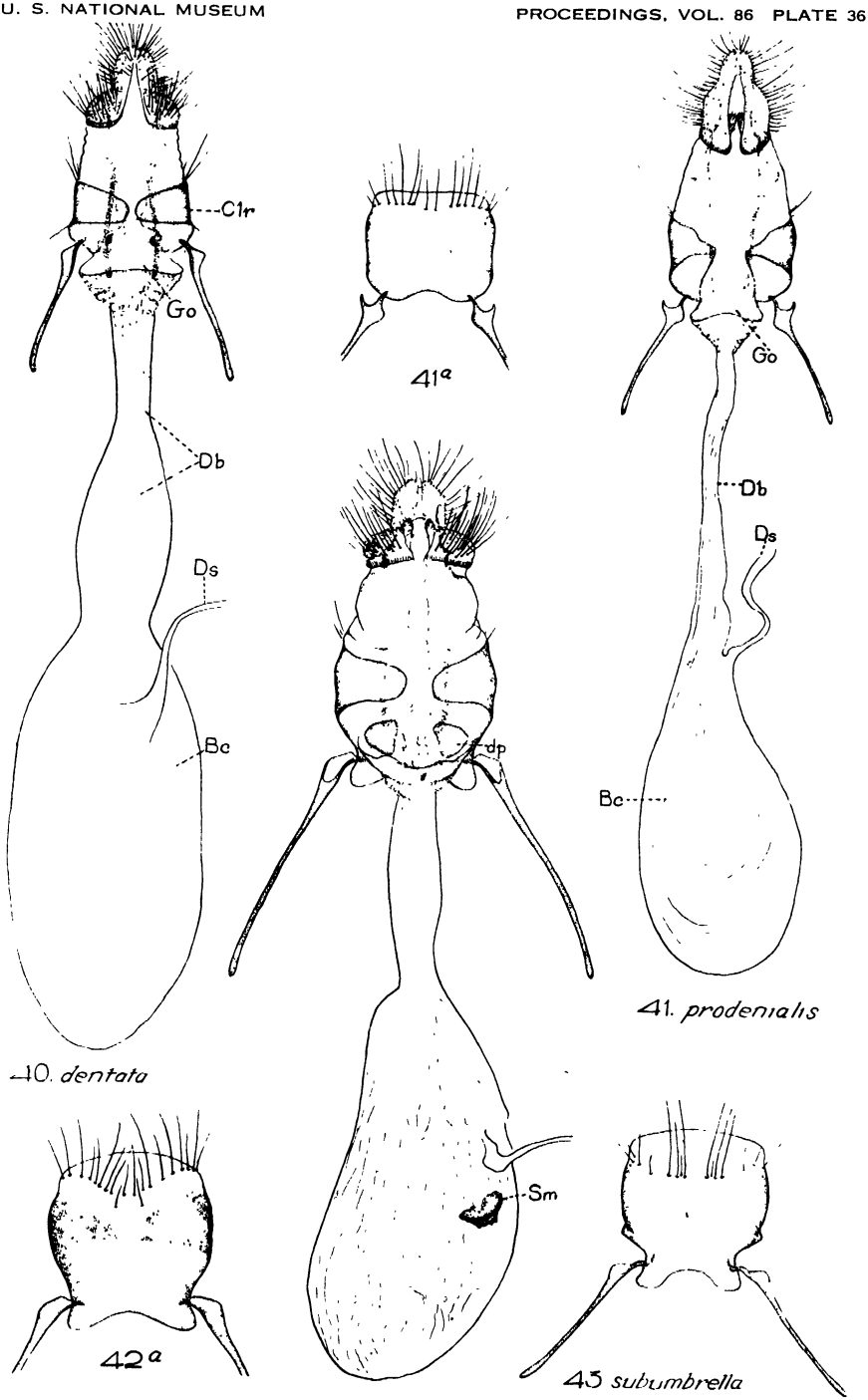
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10. *dentata*

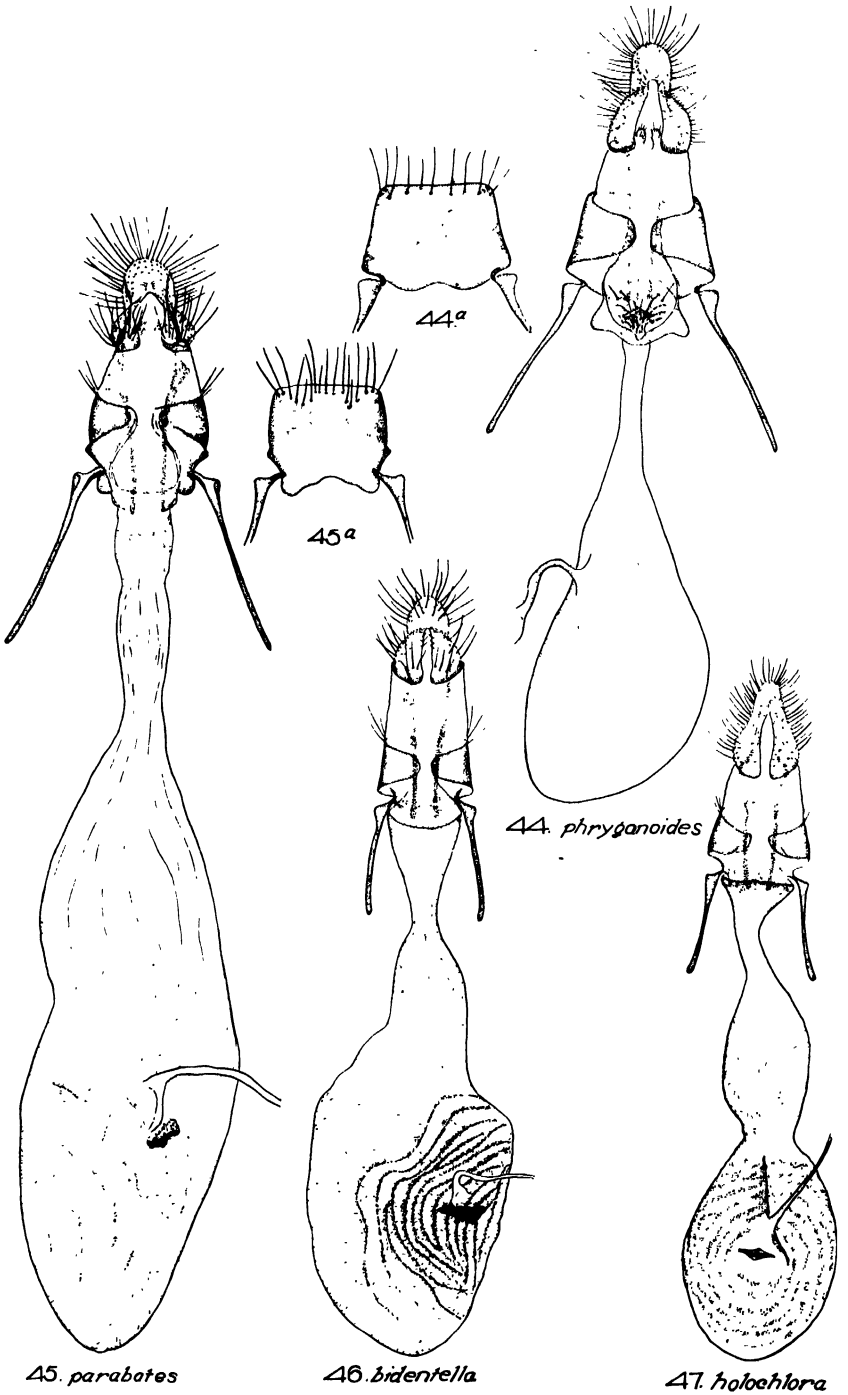
41. *prodenialis*

42. *junctolineella*

43 *subumbrella*

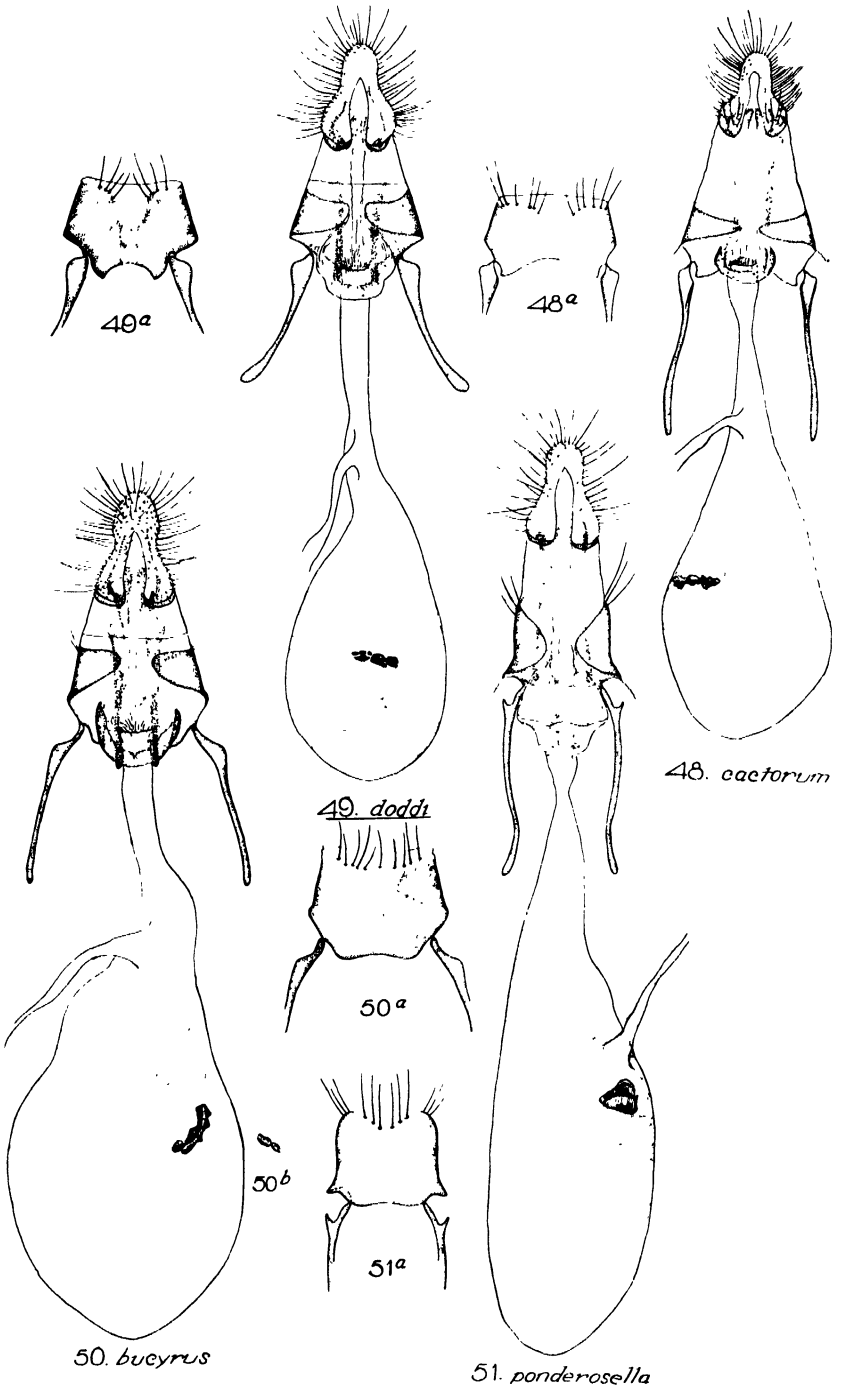
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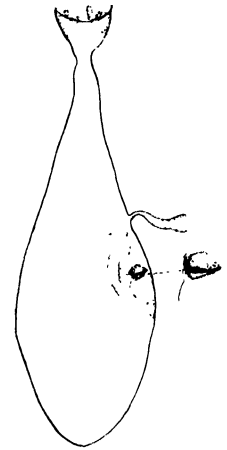
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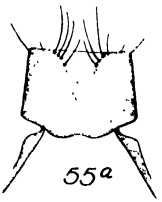


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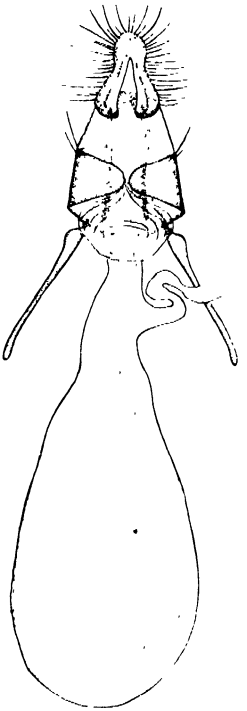
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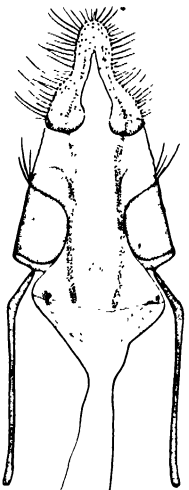
52. glaucatella

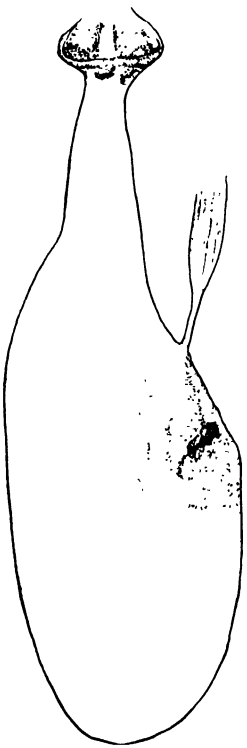


55a



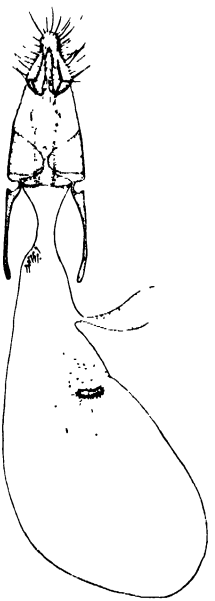
55. leuconips





53 potingella

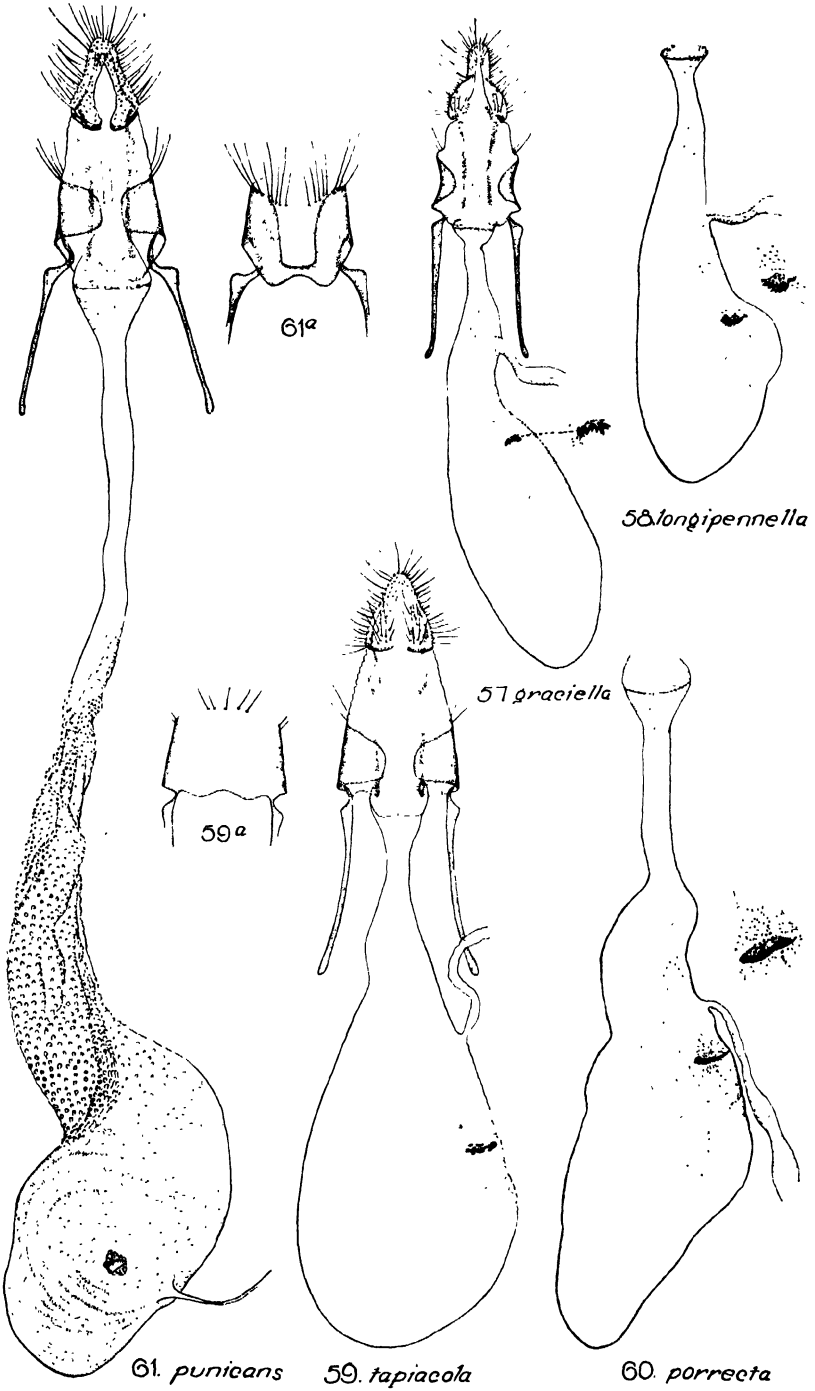
54 bihinda



56. Yosemitia sp.

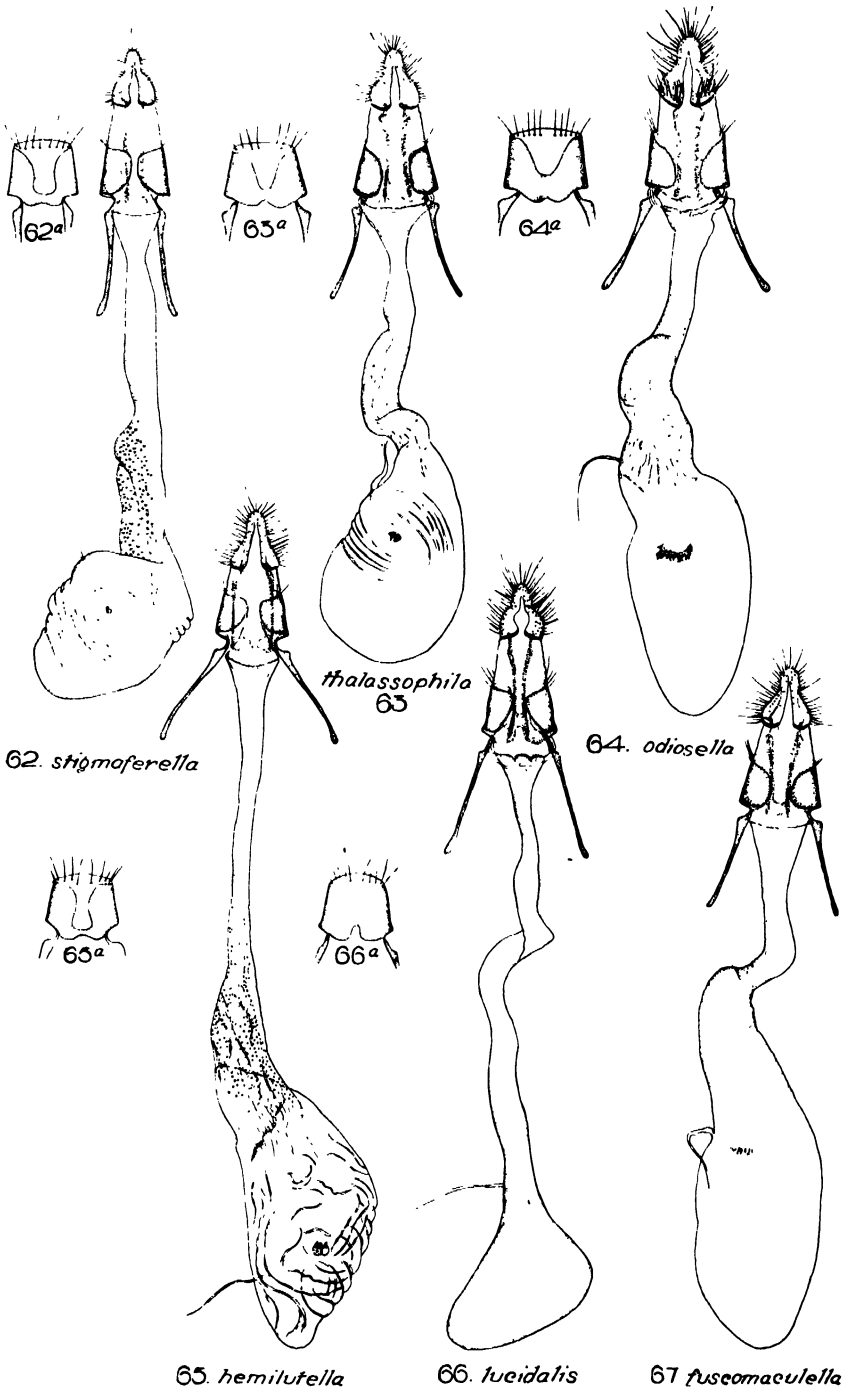
CACTUS-FEEDING PHYCITINAE.

FOR EXPLANATION OF PLATE SEE PAGE 410.



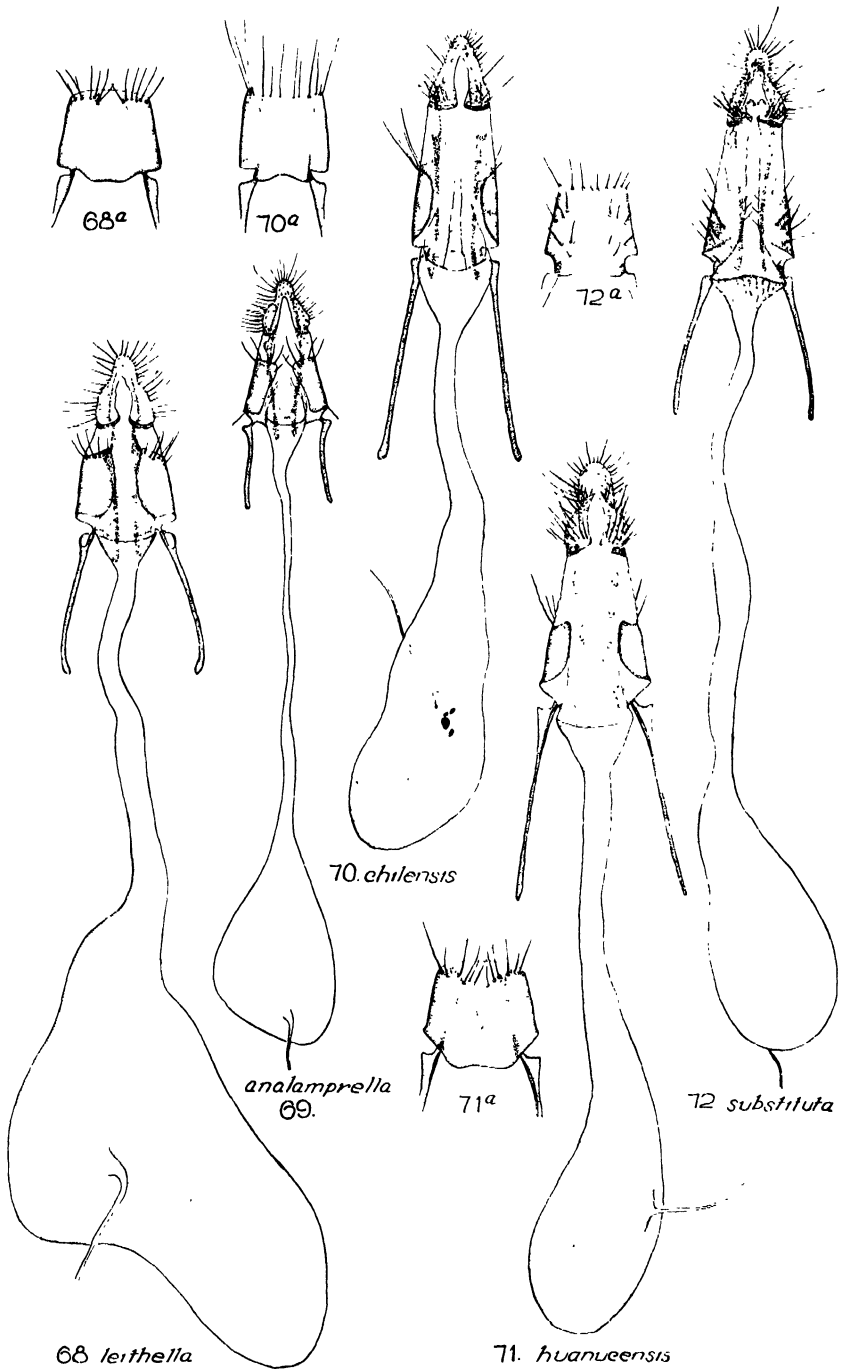
CACTUS-FEEDING PHYCITINAE.

FOR EXPLANATION OF PLATE SEE PAGE 410.



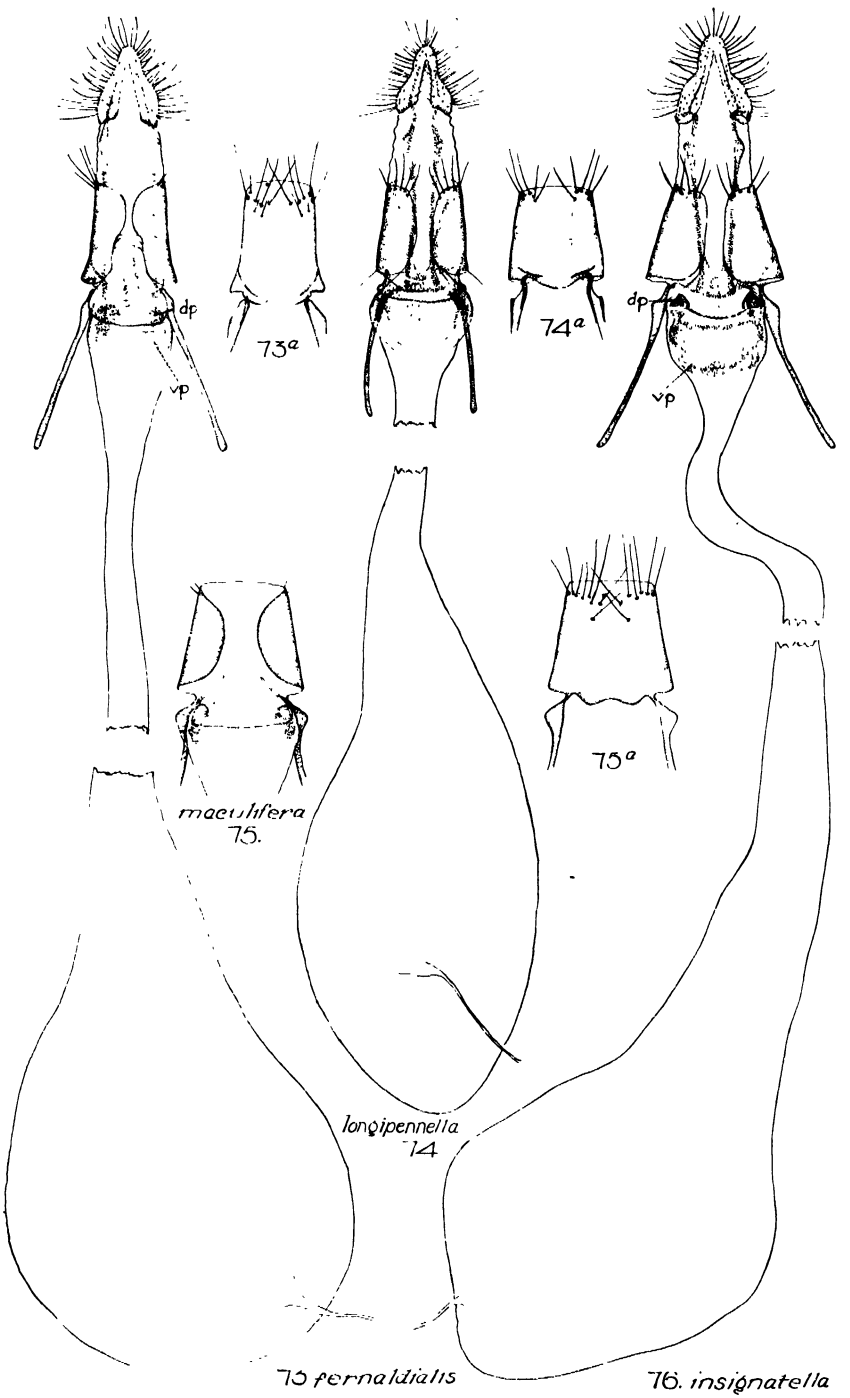
CACTUS-FEEDING PHYCITINAE.

FOR EXPLANATION OF PLATE SEE PAGE 410



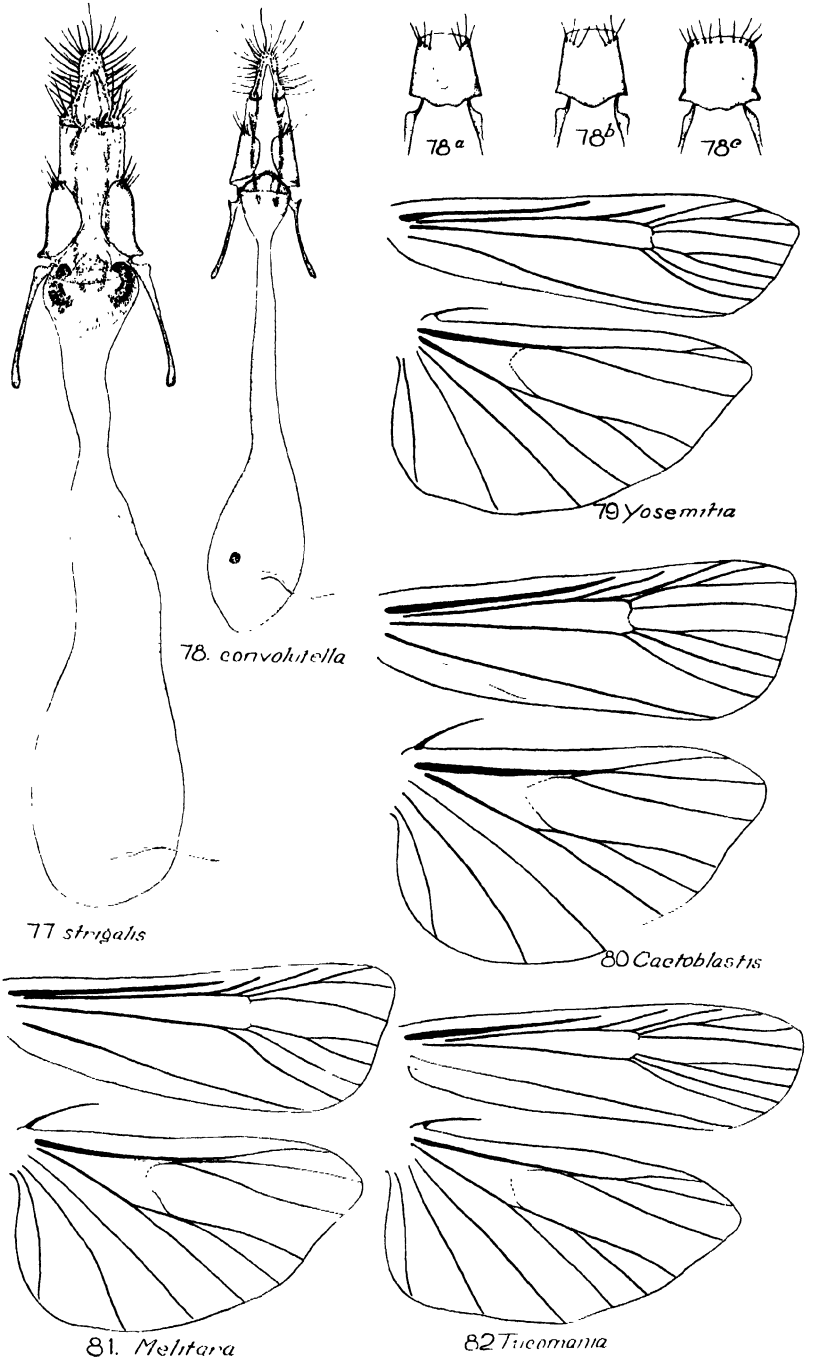
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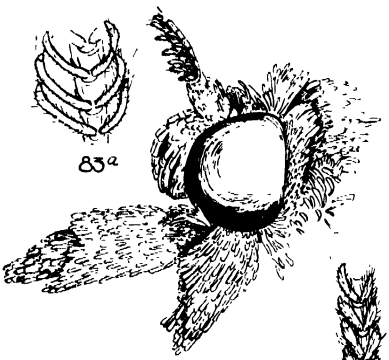
CACTUS-FEEDING PHYCITINAE.

FOR EXPLANATION OF PLATE SEE PAGE 411



CACTUS-FEEDING PHYCITINAE.

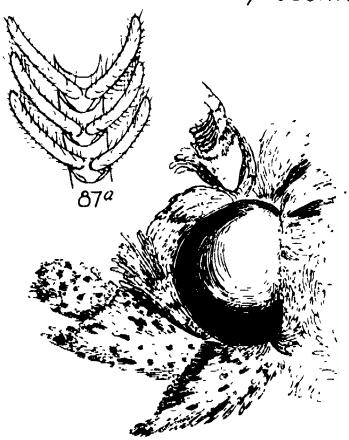
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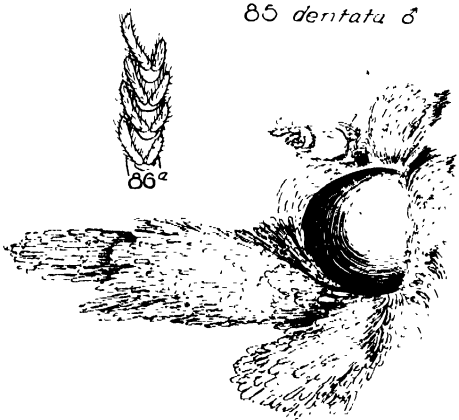
83 prodenialis ♂ 84 prodenialis ♀.



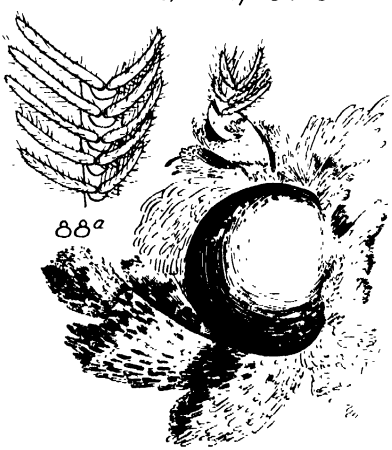
85 dentata ♂



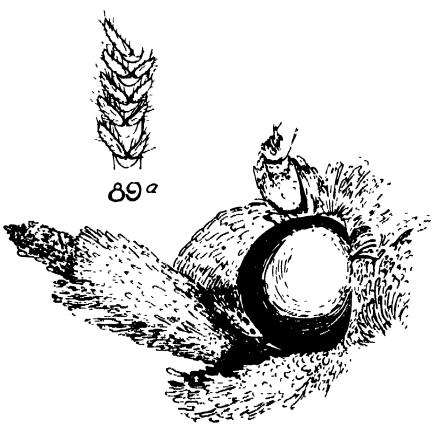
87. nephelepasa ♂



86 dentata ♀.



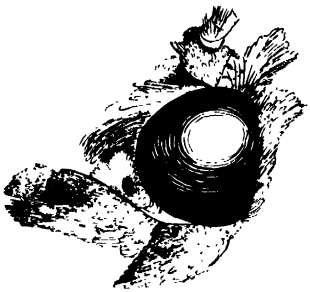
88 junctolineella ♂.



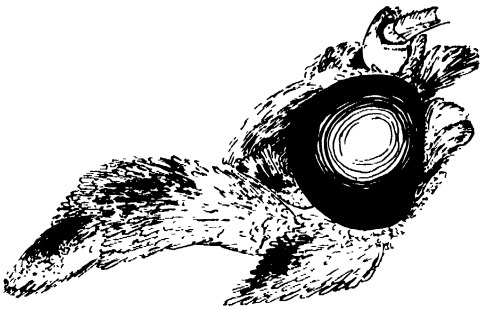
89. junctolineella ♀

CACTUS-FEEDING PHYCITINAE.

FOR EXPLANATION OF PLATE SEE PAGE 411.



90. *phryganoides* ♂



91 *phryganoides* ♀



92a

92. *parabates* ♂



94a



94. *holochlora* ♀

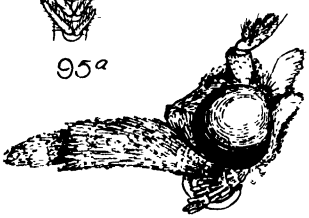


93a

93. *parabates* ♀.



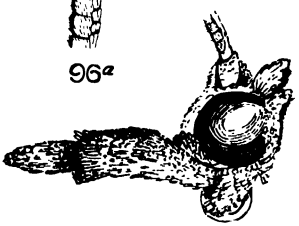
95a



95. *bidentella* ♂



96a



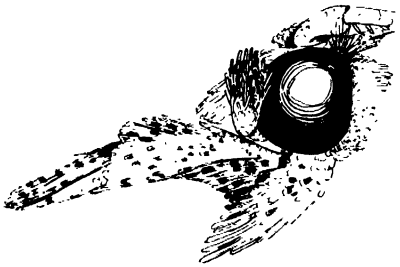
96. *bidentella* ♀

CACTUS-FEEDING PHYCITINAE.

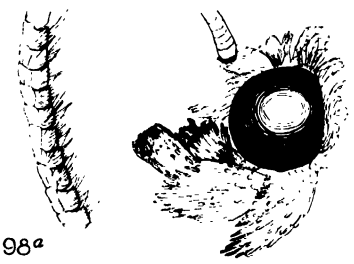
FOR EXPLANATION OF PLATE SEE PAGE 411.



97a

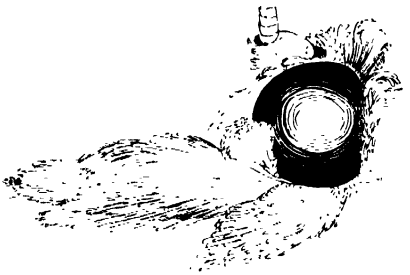


97. *substituta* ♂.

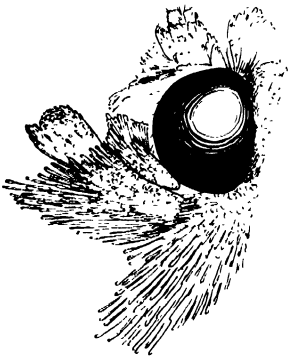


98a

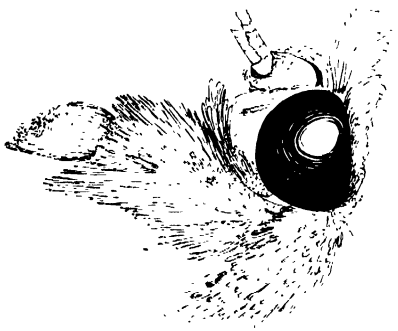
98 *cactorum* ♂



99. *cactorum* ♀



100. *mundelli* ♂



101. *mundelli* ♀



102a



102. *ponderosella* ♂

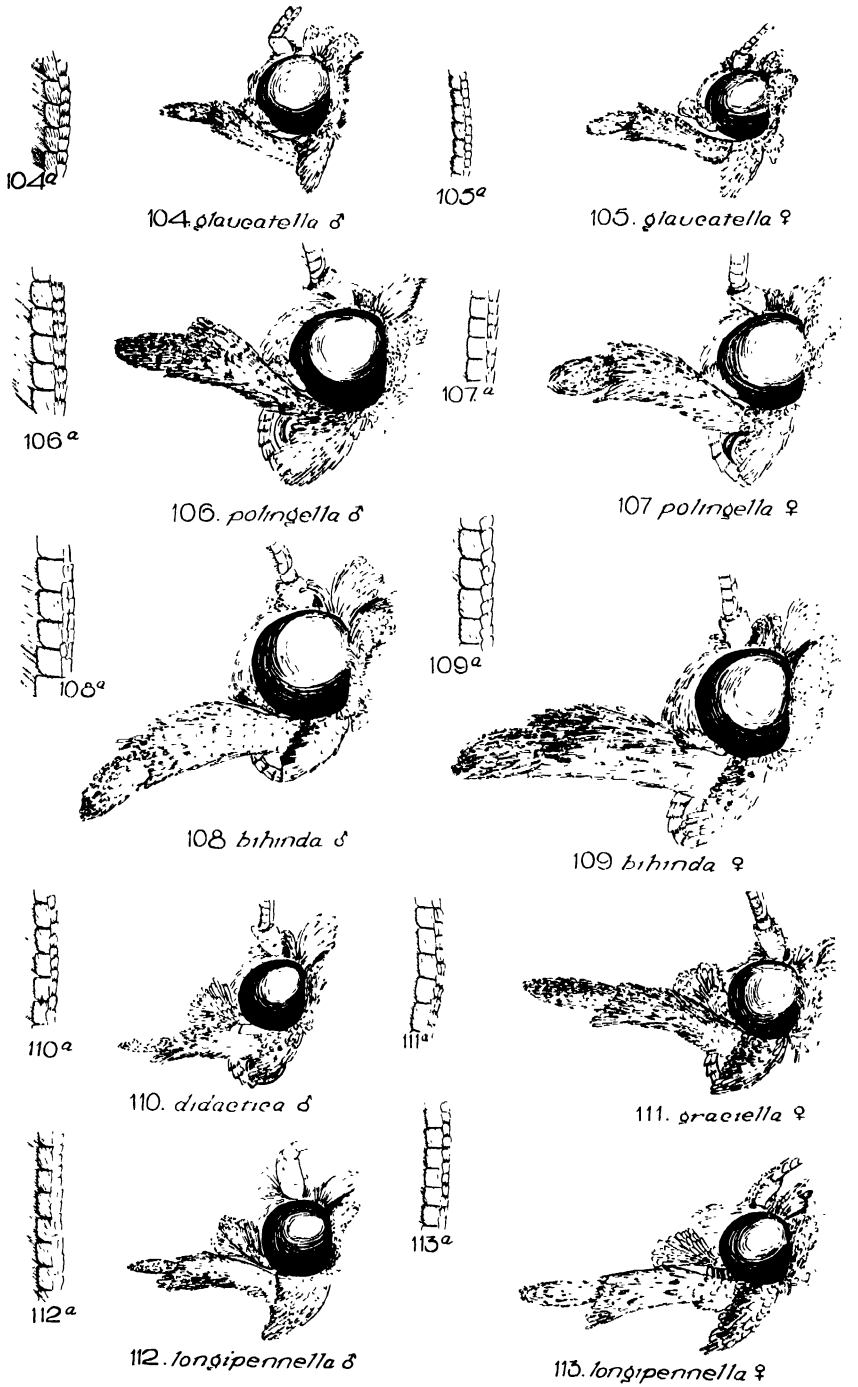


103a

103 *ponderosella* ♀

CACTUS-FEEDING PHYCITINAE.

FOR EXPLANATION OF PLATE SEE PAGE 412.



CACTUS-FEEDING PHYCITINAE.

FOR EXPLANATION OF PLATE SEE PAGE 412



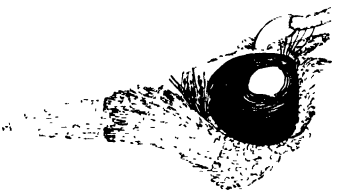
114 *fieldiella* ♂



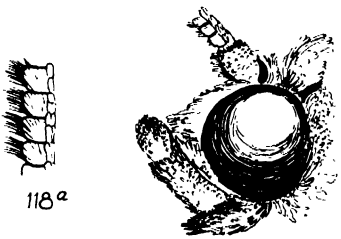
115 *fieldiella* ♀



116. *analamprella* ♂



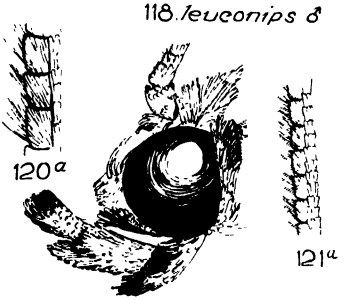
117. *analamprella* ♀



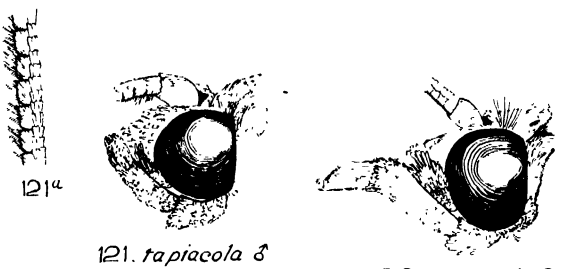
118. *leuconips* ♂



119 *leuconips* ♀

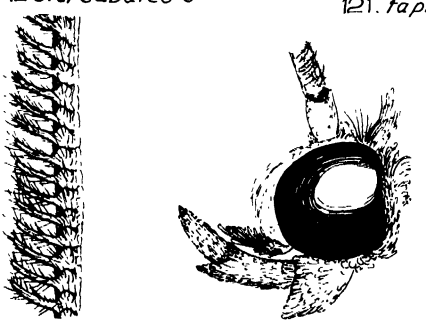


120. *creabates* ♂

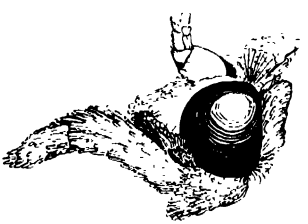


121. *tapiacola* ♂

122. *tapiacola* ♀



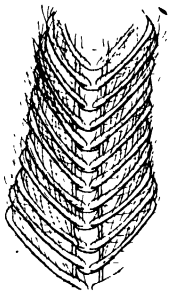
124. *asthenosoma* ♂



123. *porrecta* ♀

CACTUS-FEEDING PHYCITINAE.

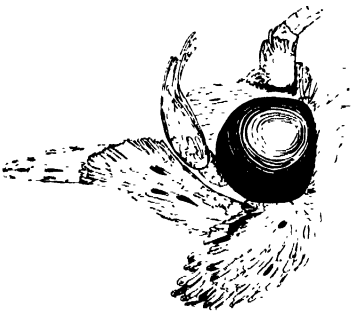
FOR EXPLANATION OF PLATE SEE PAGES 412, 413.



125a



125. chilensis ♂



126. chilensis ♀



127a



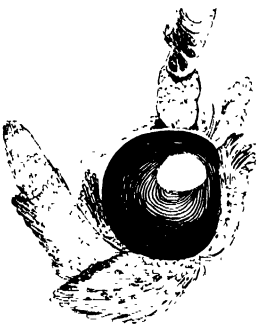
127b



127c



127. transilis ♂



128 leithella ♂



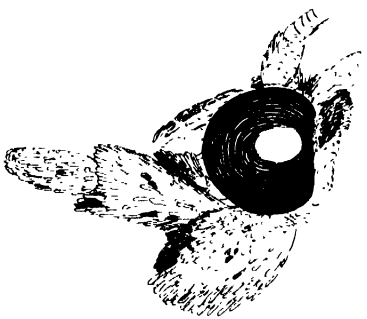
128c



128b



128a



129 leithella ♀



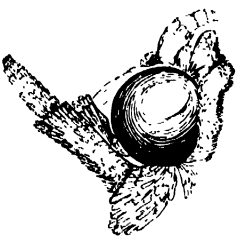
130a.



130 fuscomaculella ♂



131a



131. thalassophila ♀

CACTUS-FEEDING PHYCITINAE.

FOR EXPLANATION OF PLATE SEE PAGE 413.



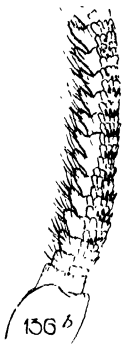




132 convolutella ♂



133. convolutella ♀









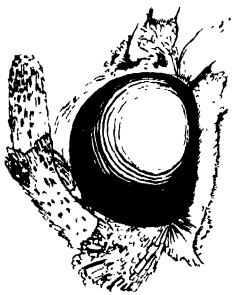


maculifera ♂



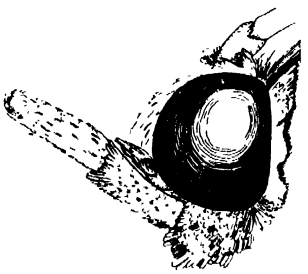






134. fernaldialis ♂





135. fernaldialis ♀

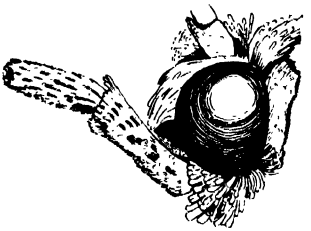


136. longipennella ♂



138. strigalis ♂





139. strigalis ♀

CACTUS-FEEDING PHYCITINAE.

FOR EXPLANATION OF PLATE SEE PAGE 413.

PROCEEDINGS OF THE UNITED STATES NATIONAL MUSEUM

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TWO NEW OPHIURANS FROM THE SMITHSONIAN-HARTFORD EXPEDITION, 1937

By HUBERT LYMAN CLARK

NEW echinoderms from the shallow waters of the West Indies are still to be expected, but it is probable that our knowledge of the littoral forms will not require the addition of many new names to the list. It was therefore a great surprise to find that each of two specimens, kindly sent to me for examination by Austin H. Clark, of the U. S. National Museum, proves to represent an undescribed species. Each, moreover, is a representative of one of those large and heterogeneous genera our knowledge of which is too superficial or fragmentary to permit its dismemberment into smaller and more natural groups.

It is always regrettable to describe a new species from a unique specimen and never more so than in such genera, but on the other hand such unique specimens must have names assigned to them if they are to be of any value in extending our knowledge of those genera. This is the only justification for publishing the following descriptions.

I wish to thank Mr. Clark for his generous kindness in permitting me to examine and describe these interesting novelties.

Genus OPHIACTIS Lütken

OPHIACTIS NOTABILIS, new species

PLATE 52, FIGURES 1, 2

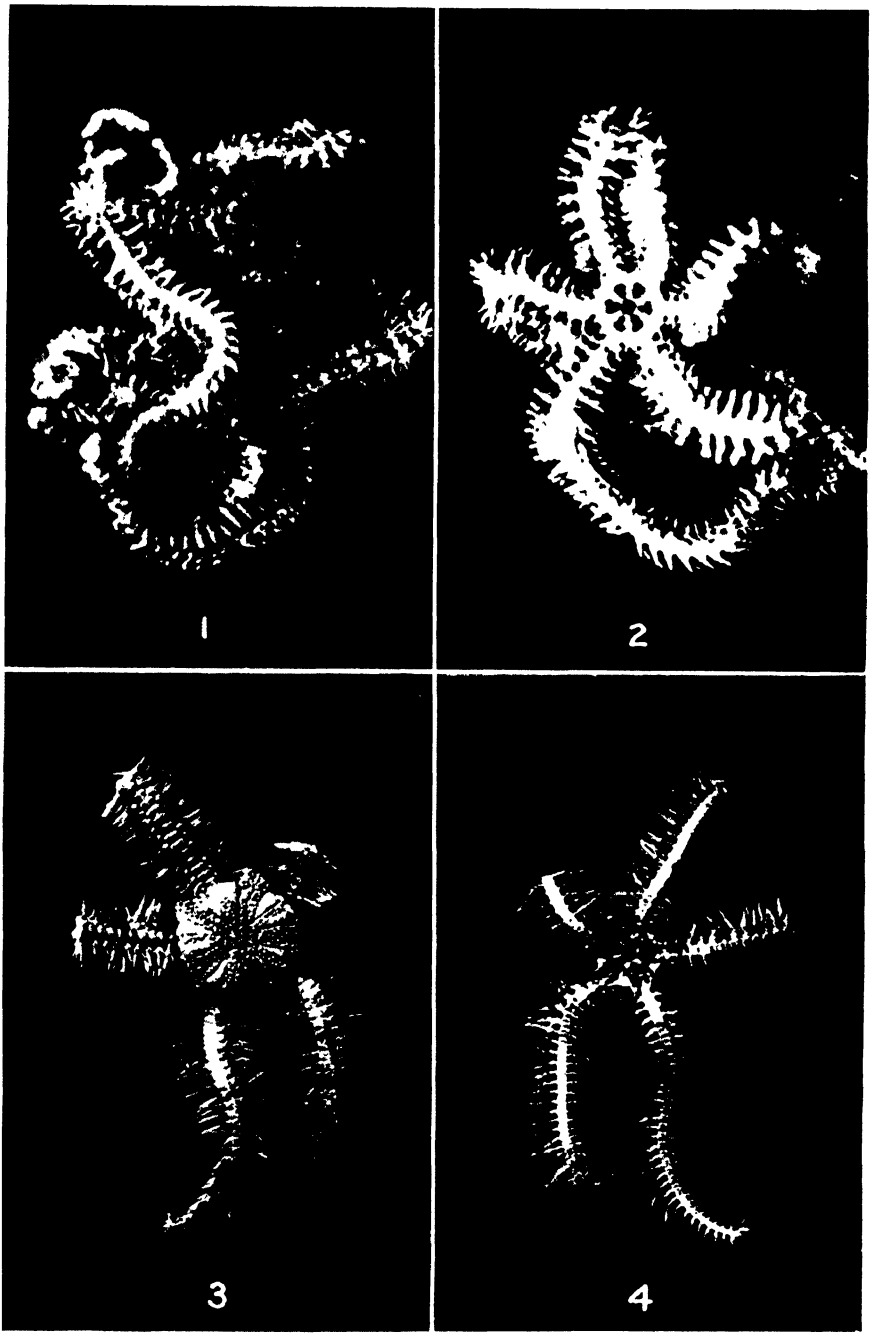
Description.—Disk very nearly 5 mm in diameter, hexamerous, slightly puffed out in the interradii and somewhat elevated, though irregularly, on the upper surface. The disk covering consists of

oval or circular, flat or slightly convex scales, scarcely or not at all overlapping, and 6 pairs of radial shields, which are flat and very small, but little larger than the largest of the disk scales; the two radial shields of each pair are separated from each other or are barely in contact distally. The interbrachial areas below are covered near the margin with thin, flat, rounded scales, like those of the upper surface but much more evidently overlapping; toward the mouth the scales are lacking and only a thin dark skin covers the area near the oral shields; there are no granules or spinelets on the disk, either above or below.

Arms 6, rather short, less than 15 mm long, slender at tip. Upper arm plates at base of arm at least twice as wide as long, very completely in contact but the proximal side is not quite so long as the distal; the lateral margins are very evenly rounded, with no hint of angles; near the tip of the arm the plates are much smaller and more nearly separated from each other, the proximal side having become a more or less truncated point, the general form of the plate being triangular.

Oral shields small, somewhat elliptical, wider than long, not so large as the first under arm plate. Adoral plates relatively very large, narrow and truncate in front of the oral shield, where they are in contact, much wider, and rounded, radially, where they meet and almost overlap in front of the first under arm plate. It is possible that these wide ends cover over and conceal the true first under arm plate and that the apparent first under arm plate is really the second. Oral papilla single, located on the small narrow oral plate; it is about twice as high as wide, flattened, and truncate or bluntly pointed at tip; apparently it is easily knocked off for several appear to be wanting; on only one jaw is the papilla present on both sides. Under arm plates, except the apparent first, which is smallest and evidently wider than long, squarish with rounded corners; the distal end is a trifle wider than the proximal and its margin is very slightly convex; lateral margins a very little concave; at the tip of the arm the plates are much longer than wide; they are more or less fully in contact throughout. Side arm plates low and small, meeting above near tip of arm, but not below; each carries a series of 4 arm spines, of which the uppermost and lowest are smallest and subequal; the other two are also subequal, but noticeably longer, about equaling the width of the arm; all the spines are blunt and obviously thicker at base than near tip; compared to the arm spines of *O. savignyi* they could be called slender. Tentacle scale single, flat, rounded, and relatively large, as usual in the genus.

Color of dry specimen very pale gray above, with a slight yellowish tinge, cream white below; a dusky blotch is visible on the upper side of most of the larger arm spines.



TWO NEW OPHIURANS.

1, 2. *Ophiactis notabilis:* Aboral (1) and oral (2) sides. ×4½.
3, 4. *Ophiothrix platyactis:* Aboral (3) and oral (4) sides. ×2½.

Holotype.—Station 19; Puerto Rico; off Puntilla Point, parallel to Tablazo Shoal; 3½ fathoms; broken shell, broken coral, and mud; W. L. Schmitt, March 29, 1937 (U.S.N.M. no. E. 5590).

Remarks.—This little *Ophiactis* is quite different from any known West Indian species. The disk covering may owe its peculiarities to being regenerated, though the appearance of the basal upper arm plates does not support such a hypothesis. But the oral papillae are very distinctive, and the color, the arm plates, and the arm spines, taken in connection with the number of arms, give this *Ophiactis* a status quite apart from any other species now known.

Genus OPHIOTHRIX Müller and Troschel

OPHIOTHRIX PLATYACTIS, new species

PLATE 52, FIGURES 3, 4

Description.—Disk 6 mm in diameter, quite flat, covered by relatively few scales and the 5 pairs of radial shields; the latter are large, triangular, 2 mm long and 1 mm wide distally, sharply pointed at inner end; in each pair the shields are markedly separated from each other, except at the distal inner corner where they may touch; the surface of each shield is bare and smooth except for the presence of 2 to 5 minute irregularly scattered rounded granules. Disk scales comparatively few, coarse and thick, not well defined; each scale carries 1 to 5 rounded granules much larger than those on the radial shields; at the interbrachial margins these granules are higher than thick and might be called low spinelets. Interbrachial areas below covered with thin overlapping scales, much more delicate than those of the upper surface; near the margin of each area are a very few low blunt spinelets.

Arms 5, short and flat, probably less than 30 mm in length, wide at base but slender at tip. Upper arm plates much wider than long, more or less triangular with all angles rounded; the basal plates have the proximal angle truncated, as they are obviously in contact with each other, but this proximal margin is not half so long as the distal, which is twice the plate length or even more and straight or flattened-convex; the surface of the plates is very finely roughened, not nearly so coarse, however, as to be called shagreenlike.

Oral shields much wider than long, with a small blunt proximal angle, a nearly straight distal margin, and rounded lateral ends. Adoral plates short and wide, in contact interradially and closely appressed to the proximal margin of the oral shield. No oral papillae, of course; the cluster of tooth papillae conspicuous as usual, but not peculiar. Under arm plates quadrilateral, the length and breadth about equal or, near base of arms, the breadth a little greater; distal margin notably concave; proximal a trifle convex or with a low

rounded median projection; all four corners rounded; the plates are more or less in contact at the sides but not in the median line. Side arm plates low, not meeting distinctly either above or below; each carries a series of 6 to 8 slender, blunt, somewhat flattened arm spines, which are conspicuously thorny, at least along the sides; the uppermost spine is very small, but sharp and thorny; the second is more than twice as long, the third is much longer still, and either it or the fourth is the longest of the series, the length exceeding the width of the arm; succeeding spines are shorter and more slender, the lowest one or two (sometimes three) being notably slender, more or less smooth except at tip, and blunt. Tentacle scale minute, flat and rounded.

Color of dry specimen pale gray on disk and upper arm plates, the disk granules somewhat lighter; at base of arm the middle of each upper arm plate is very slightly lighter than the sides and one can almost detect a wide whitish longitudinal line thus marking the upper surface of the arm. But this is to be detected only in the best light; farther out on the arm each plate has a faint ill-defined whitish area at center and on a few plates this has the shape of an hourglass; there are no dark lines or markings on the upper surface of either disk or arms. Arm spines glassy at base but becoming distinctly pink at the tips. Oral surface nearly white, but the interbrachial areas are gray and the under arm plates and the spines have more or less of a pinkish tinge.

Holotype.—Station 56; Barbados; Pelican Island, Carlisle Bay; cracked from old blocks of coral; W. L. Schmitt, April 19, 1937 (U.S.N.M. no. E. 5591).

Remarks.—This curious little *Ophiothrix* was first recorded by Austin H. Clark (1921, Univ. Iowa Studies in Nat. Hist., vol. 9, no. 5, p. 54) under the name of *Ophiothrix lineata.* In 1933 (Handbook of Littoral Echinoderms of West Indies, p. 62) I made the futile suggestion, based on the locality and habitat, that the specimen "must be a peculiar individual" of *O. suensonii.* I was much farther from the truth than my colleague, for there is no doubt that *platyactis* is much nearer to *lineata* than it is to *suensonii.* It is readily distinguished from all its West Indian congeners by the disk covering, the upper arm plates, the arm spines, and the coloration. The shape of the upper arm plates and spines and the absence of dark lines on the upper side of the arms separate it sharply from *lineata* and even more readily from *suensonii*, which it does not resemble at all.

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NEW SPECIES OF FLATWORMS FROM NORTH, CENTRAL, AND SOUTH AMERICA

By LIBBIE H. HYMAN

A NUMBER of preserved specimens of Turbellaria collected in various parts of North, Central, and South America sent to me for identification by the United States National Museum have all been found to be new species except one. Most of these were fortunately in full sexual maturity, so that it is possible to furnish a complete diagnosis. Those not in the sexual state are also undoubtedly new forms, but a complete description of them must await the fortunate finding of sexually mature material.

Order TRICLADIDA

Suborder PALUDICOLA, or PROBURSALIA

Family PLANARIIDAE

Genus DUGESIA Girard, 1850

In the author's opinion, *Dugesia* Girard is a valid genus, of which *Euplanaria* Hesse, 1897, is a synonym.

DUGESIA TITICACANA, new species

FIGURE 47, *a–c*

Material examined.—Three specimens, two sexually mature, third young. Both sexual specimens cut into sagittal serial sections, but in one the posterior end with the copulatory apparatus was missing. The other one has hence been made the type.

Description.—External appearance typical of the genus; type specimen (fig. 47, *a*) 5 mm long, 1.8 mm wide, contracted, hence longer and slenderer in life. Head bluntly triangular with blunt auricles and usual two eyes. Pharynx behind the middle.

Color.—Black above, evenly granular, auricles lighter, dark brown below.

Histology.—Dorsal epithelium very thickly beset with rhabdites (fig. 47, *b*); beneath the dorsal epithelium a very wide pigmented region in the parenchyma; just inside this pigmented zone occur the numerous rhabdite-forming gland cells (fig. 47, *b*). Rhabdites, pigment, and rhabdite-forming cells much fewer ventrally than dorsally. Adhesive zone (fig. 47, *b*) very conspicuous at the posterior end, less so at the anterior end; otherwise this species is rather devoid of gland cells. Longitudinal fibers of the subepithelial muscle layer well developed.

Reproductive system.—Typical of the genus. Testes numerous, ventral, of moderate size, extending from just behind the ovaries to the posterior end. Vasa deferentia forming the usual expanded "false" seminal vesicles packed with sperm alongside the pharynx to near their entrance into the penis bulb. Penis typical of the genus, with evident bulb and papilla (fig. 47, *c*). Penis bulb of rounded form containing many muscle fibers coursing parallel to its external contour. The slender terminations of the two vasa deferentia pass separately and without enlargement through the penis bulb and open into the sides of a rounded cavity, the true seminal vesicle, in the penis bulb. This cavity is lined by a tall glandular epithelium, which receives the granular outlets of gland cells situated in the parenchyma of the penis bulb. Penis papilla short, truncate, with a central depression containing a papilla on which the ejaculatory duct opens. The ejaculatory duct is directly continuous with the seminal vesicle in the penis bulb and is lined by a cuboidal epithelium. Penis papilla clothed with a thin epithelium beneath which is a thick layer of circular muscles. Its interior consists of parenchyma with loose longitudinal muscle fibers continuous with those encircling the penis bulb. Ovaries typical, somewhat more posterior to the eyes than the latter are to the anterior tip. The oviducts proceed posteriorly and enter separately the bursa stalk some distance above the entrance of the latter into the genital atrium. Copulatory bursa of moderate size in usual position between the penis bulb and the end of the pharyngeal chamber, saclike, lined by a tall epithelium, and with a thin layer of muscle fibers on its external surface. Bursa stalk fairly large, lined by a tall ciliated epithelium, clothed externally with a well-developed muscle layer of intermingled circular and longitudinal fibers. Genital atrium divided by a descend-

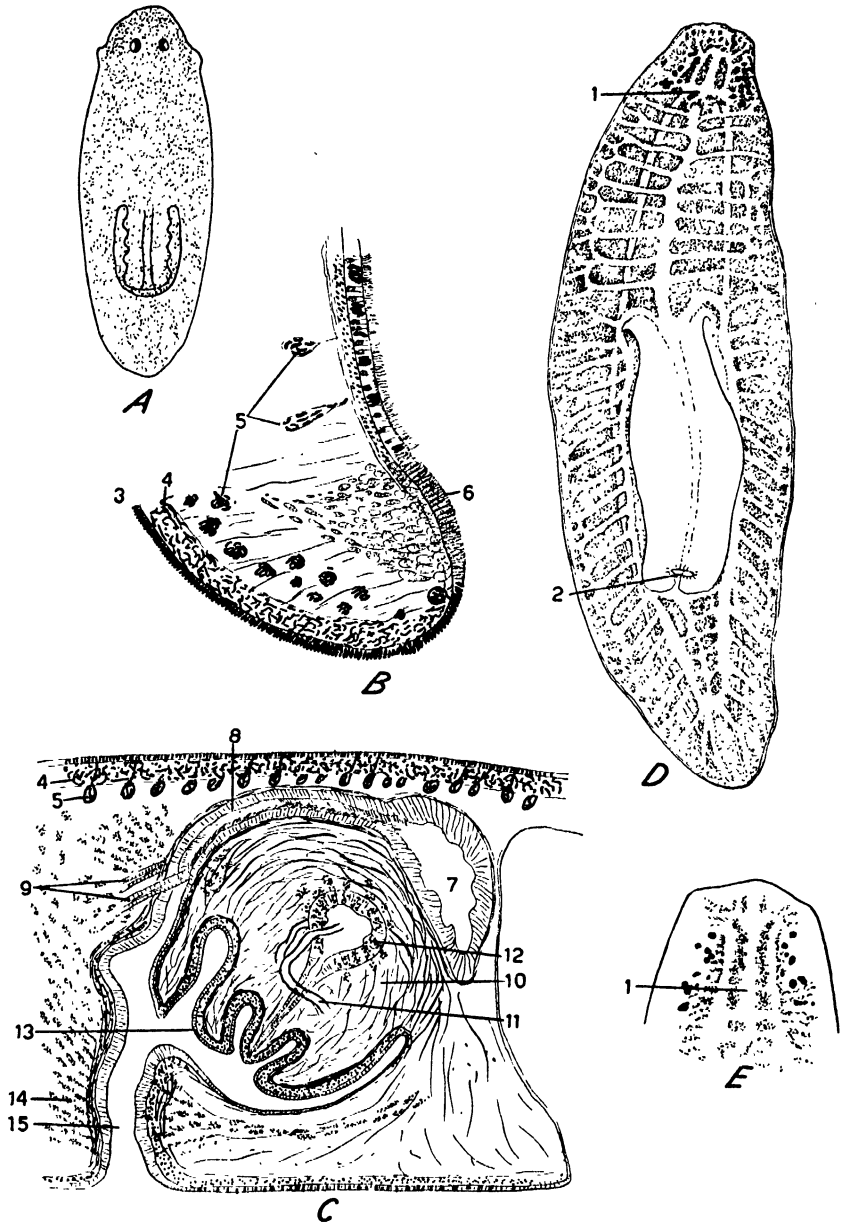


FIGURE 47.—New species of DUGESIA and SOROCELIS

a–c, Dugesia titicacana: a, Type specimen; *b,* posterior end, showing rhabdites, pigment zone, and adhesive zone; *c,* sagittal view of the copulatory complex of the type. *d, e. Sorocelis americana: d,* Entire worm; *e,* head, showing brain and eye arrangement.

1, Brain; *2,* mouth; *3,* rhabdites; *4,* pigment zone; *5,* rhabdite-forming cells; *6,* adhesive zone; *7,* copulatory bursa; *8,* stalk of same; *9,* entrance of oviducts in bursa stalk; *10,* penis bulb; *11,* vas deferens; *12,* seminal vesicle in penis bulb; *13,* penis papilla; *14,* cement glands of atrium; *15,* common genital atrium.

ing fold into a larger male portion containing the penis papilla and a smaller female portion of tubular shape, which continues above into the bursa stalk and opens below by the common genital pore. Numerous gland cells open into the female atrium, mostly from behind, some from in front below the penis, and many of them accompany the terminations of the oviducts and open into the bursa stalk where the oviducts open. Female atrium lined with a tall epithelium and clothed externally with a thick layer of intermingled circular and longitudinal muscles continuous above with the muscle layer of the bursa stalk but thicker than this and passing ventrally into the regular subepidermal muscle layer of the body wall.

Locality.—Isla de la Sol, Lake Titicaca, Bolivia, collected on February 18, 1936, by M. C. James.

Type.—As serial sections, U.S.N.M. no. 20402.

Remarks.—It is rather peculiar that all the fresh-water planarians so far known from South America (listed by Fuhrmann, 1914b, who also describes some additional species) belong to the genus *Dugesia* except "*Planaria*" *patagonica* Borelli, 1901, which apparently belongs to *Curtisia*. The *Dugesia* species are very similar in external appearance and anatomy of the copulatory apparatus; hence they are not easy to distinguish. *D. titicacana* most nearly resembles *D. festae* (Borelli, 1898), also found in high mountain lakes, in Ecuador. The principal feature wherein *D. titicacana* differs from other members of the genus is the form of the penis papilla, with its central depression bearing a papilla on which terminates the ejaculatory duct.

Family DENDROCOELIDAE

Genus SOROCELIS Grube, 1872

SOROCELIS AMERICANA, new species

FIGURES 47, *d*, *e*; 48, *a*

Material examined.—Seven preserved specimens, all asexual, probably not fully grown.

Description.—Maximum length, 5 mm, width 1.8 mm, somewhat contracted, hence longer and less plump in life. General external appearance shown in figure 47, *d*. Head truncate, center and margins slightly projecting, giving a wavy effect; the central projections contains the adhesive organ; the lateral projections correspond to auricles. Eyes numerous, in a lengthwise arc on each side of the brain, each arc composed of 10 to 20 eyes (fig. 47, *e*). Brain large, of elongated quadrangular shape, giving off numerous branches forward and laterally and the usual two ventral cords pos-

teriorly. Anterior portions of the ventral nerve cords connected by numerous connectives having a netlike arrangement (not shown in the figure). Digestive tract typically triclad (fig. 47, *d*); pharynx unusually large and prominent. Sections of the pharynx show that the circular and longitudinal fibers of the inner muscular layer are intermingled, as diagnostic of the family Dendrocoelidae. This feature serves to distinguish the dendrocoelid genus *Sorocelis* from the planariid genus *Polycelis*, which also has numerous eyes.

Color.—Preserved specimens, uniform yellowish, probably white or creamy in life.

Histology.—The principal feature is the weakly developed adhesive organ, in the center of the ventral surface of the median prominence of the anterior margin. This type of adhesive organ is characteristic of the genus. It is shown in median sagittal section in figure 48, *a*. The adhesive organ is a small pit lined with eosinophilous gland cells, whose bodies extend into the adjacent parenchyma, above and below the intestine. The regular surface epithelium containing rhabdites alters abruptly at the margins of the adhesive organ into these gland-cell outlets devoid of rhabdites. Presumably as in other similar organs, there are attenuated epidermal cells between the gland-cell outlets but they could not be seen. Some longitudinal muscle fibers, acting to deepen the pit, extend posteriorly from the organ along the ventral wall where they soon join the regular subepidermal longitudinal muscle layer. General epidermis cuboidal to low columnar, packed with small rhabdites except on the adhesive organ and the usual marginal adhesive zone; no special large marginal rhabdites such as occur in other dendrocoelids and the American cave planarians of the family Kenkiidae (Hyman, 1937). Subepidermal musculature moderately developed, weak dorsally, stronger ventrally. Numerous cyanophilous gland cells in the prepharyngeal region, especially ventrally. Many large eosinophilous gland cells dorsally in the postpharyngeal region.

Reproductive system completely absent.

Locality.—Bat Cave, Adair County, Okla., collected by A. P. Blair. No date.

Type.—As whole mount, U.S.N.M. no. 20403. Paratypes, as preserved specimens and serial sections, U.S.N.M. no. 20404.

Remarks.—This is the first finding of the genus *Sorocelis*, a typical Asiatic genus of fresh-water triclads, on the American continents. The absence of sexual material makes it impossible to differentiate *S. americana* exactly from other species of the genus, but the combination of plain white color, eye arrangement, and locality should suffice to distinguish it.

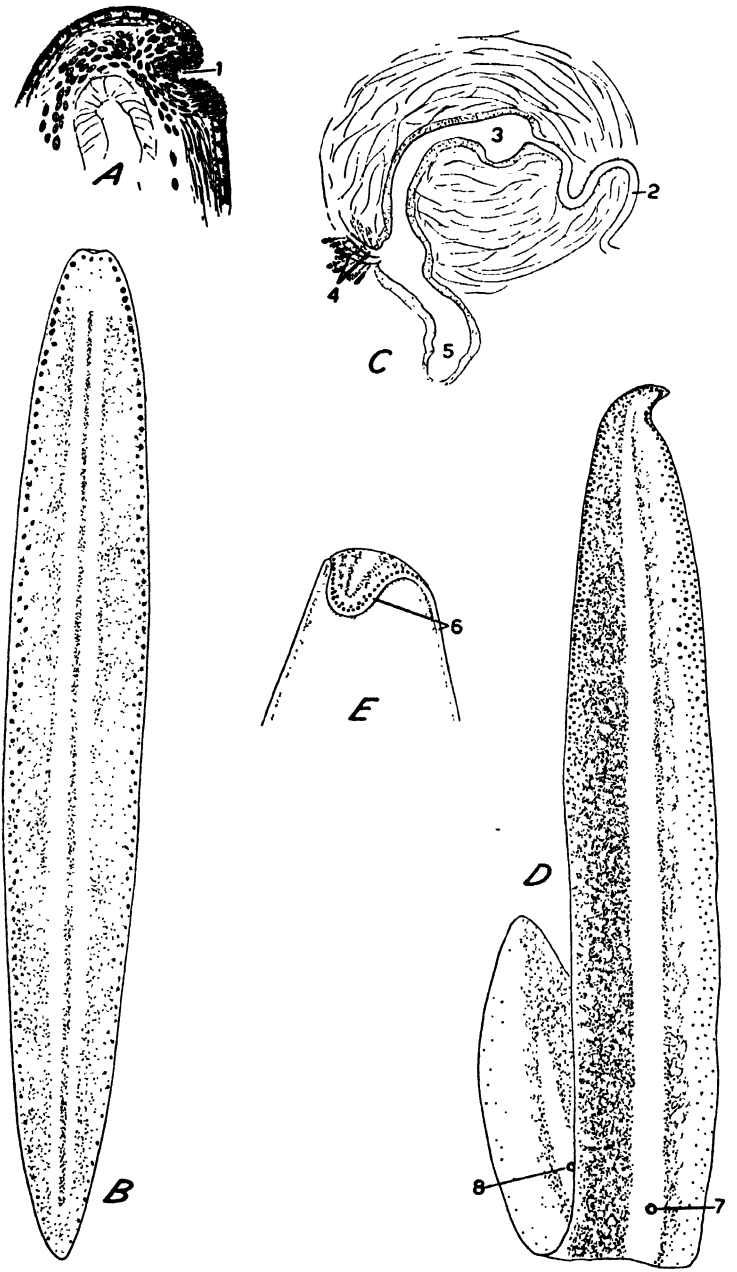


FIGURE 48.—New species of SOROCELIS and GEOPLANA

a, *Sorocelis americana:* Sagittal section of anterior end, showing the adhesive organ.
b, *c*, *Geoplana mexicana:* *b*, Type specimen; *c*, sagittal view of immature copulatory apparatus.
d, *e*, *Geoplana montana:* *d*, Type specimen; *e*, head, showing eye arrangement and Sinneskante.
1, Adhesive organ; *2*, vas deferens; *3*, male atrium; *4*, oviduct entrance; *5*, common genital atrium; *6*, Sinneskante; *7*, mouth; *8*, genital pore.

Suborder TERRICOLA

Family GEOPLANIDAE

Genus GEOPLANA Stimpson, 1857

What evidence there is available indicates that Stimpson's Prodromus (1857), or at least the signature of the Proceedings of the Philadelphia Academy containing it, was published in February 1857, while the Heft (or fascicle) containing Schultze's quotation of Müller's diagnosis of the genus was published and first available on May 2, 1857 (Abh. Naturf. Ges. Halle, vol. 4, p. 11 of the Berichte appended to the volume, 1858). Ascribing the year 1856 to *Geoplana* Müller, as do some authors, seems to be based on the fact that Leuckart referred to the paper in his "Bericht über die Leistungen in der Naturgeschichte der niederen Thiere während des Jahres 1856" (Archiv für Naturg., Jahrg. 23, Band 2, p. 209, 1857), but this note was published in 1857 and the earliest date assigned to the Müller description of the genus is that of the reprint, "auch als Separatabdruck Halle 1857" (Leuckart).

GEOPLANA MEXICANA, new species

FIGURE 48, *b*, *c*

Material examined.—Two specimens, both immature. Larger specimen selected as type.

Description.—Type, 16 mm long, 2 mm wide at widest part, with an appearance typical of the genus (fig. 48, *b*). Head bluntly pointed, upturned, body increasing in width to about the middle, then tapering to the pointed posterior end. Eyes numerous, extending along the entire margin and across the ventral surface of the anterior end, larger and in single file anteriorly, becoming smaller and less regular in arrangement throughout the middle portion of the body, and few and widely spaced in single file toward the posterior end. About 85 eyes were counted on each side of the type specimen, but the number probably increases with age.

Color.—A slender middorsal dark stripe, bordered on either side by a wider light stripe, then dark to the lateral margins. The dark part of the dorsal surface is a deep brownish black; the two light stripes are probably yellowish in life. Ventral surface uniform medium brown.

Reproductive system.—The type specimen was cut into serial sections, but unfortunately it was only at the onset of sexuality. Testes numerous, ventral, throughout most of the body length. Copulatory apparatus immature, genital pore not yet formed; what was present

is shown in figure 48, *c*. Penis papilla absent; the vasa deferentia enter the anterior end of an elongated tubular chamber, which curves ventrally and after receiving the two oviducts proceeds ventrally and disappears without connecting with the ventral surface. Presumably this ventral extension is the common genital atrium, which would later open through the ventral surface. The whole is surrounded by a tissue rich in muscle fibers. This early condition of the copulatory apparatus closely resembles von Graff's figure (1899, p. 166) of a similar stage of another *Geoplana* species, and in fact it appears that throughout the Terricola the copulatory apparatus generally passes through such a stage. Hence it is impossible to draw any conclusions as to the structure of the mature apparatus of *Geoplana mexicana* from the immature specimen. *G. mexicana* can be differentiated from other members of the genus at present only on the basis of the color pattern.

Locality.—Mexico. The label reads: On violets from Mexico (in cargo) intercepted at Laredo, Texas, Sept. 10, 1935, by M. G. Vinzant."

Type.—As serial sections, U.S.N.M. no. 20405. Paratype, preserved, U.S.N.M. no. 20406.

Remarks.—This species and two others (one known and one new) from Yucatan recently described by the author (Hyman, 1938) are the first land planarians to be recorded from Mexico. They probably represent but a fraction of the terricolous planarians of that country.

GEOPLANA MONTANA, new species

FIGURES 48, *d*, *e*; 49, *a-d*

Material examined.—Four specimens, one small and immature, one in bad condition, the two others fully mature and in a satisfactory state. The one with the best-preserved coloration selected as the type, the other as paratype.

Description.—Type specimen 50 mm long, width at middle of body 5 mm; paratype larger, 70 mm long, 6.5 mm wide at widest region. Head small, rounded (fig. 48, *e*), body quickly widening to a broad flat shape, which it retains to near the posterior end, there tapering to a point (fig. 48, *d*).

Eyes very numerous, a thousand counted on each side of the type specimen, in single file or slightly doubled on the head, quickly increasing to form a broad irregular band several eyes deep toward the middle of the worm, then diminishing in size and number to the posterior end (fig. 48, *d*). Figure 49, *a*, gives the details of the eye arrangement from a region of the body where the eyes are most numerous. The eyes continue around the anterior margin of the head (fig. 48, *e*) bordering the "Sinneskante," or sensory margin, a

white strip of sensory nature forming the body edge. The Sinneskante has been fully treated by von Graff in his classical monograph on the Terricola (1899). Cross section of the body crescentic, gently convex above, plane or slightly concave below, entire ventral surface modified to a creeping sole, as in other members of the genus. Mouth about three-fourths the body length from the anterior end; genital pore of type specimen 7 mm posterior to the mouth. Postpharyngeal portion of the body of both type and paratype removed and cut into serial sagittal sections.

Color.—Dorsal surface with a broad middorsal light-yellow stripe, rest of dorsal surface with a mottled dark-brown pattern on the same light-yellow background (fig. 48, *d*). Details of the pattern in a lateral half are shown in figure 49, *a*; there is simply an irregular marbling with dark brown and light yellow. In the paratype there appears to be more yellow and less dark brown in the marbled pattern with larger yellow areas near the margin; but it is probable that the color has faded during the long sojourn in alcohol. Ventral surface dull white, with a little brown pigment on the head.

Reproductive system.—Both specimens have a mature copulatory apparatus, but the accompanying gland cells are much better developed in the paratype. Sagittal section combined from type and paratype shown in figure 49, *b*. The genital pore leads dorsally into the large genital atrium, divisible into an anterior extension, the male atrium, containing the penis papilla, and a posterior extension, the female atrium. Penis with poorly developed bulb; penis papilla large, of elongated conical form, extremely muscular, the interior filled with sinuous muscle fibers, which course mostly in a longitudinal direction and at the penis base curve posteriorly to become continuous with the muscle layer of the genital atrium and the parenchymal fibers. The penis papilla is clothed with a low cuboidal epithelium in which cell walls could not be distinguished (fig. 49, *c*); beneath the epithelium there appears to be no definite muscle layer except toward the penis base but a syncytial network. This is crossed at intervals by bundles of muscle fibers, which reach the surface of the penis, sometimes elevating this into a small papilla. Where these muscle bundles come to the surface, the regular epithelium appears to be modified (fig. 49, *c*), but the available sections are not thin enough to reveal the histology of the terminations of these muscle bundles. They seem to inclose some large cells, which may be gland cells. Fuhrmann (1914a) has observed similar muscle bundles terminating in papillae in the penis of *Geoplana vonguteni* from Colombia. He believes these papillae contain gland cells whose contents are squeezed out by the muscle fibers encircling them. He also found the muscle bundles indicated in *Geoplana cameliae*. Penis

papilla traversed throughout its length by the tubular ejaculatory duct lined by a cuboidal ciliated epithelium. At the penis base, the duct curves ventrally, then turns anteriorly, enlarging into an elongated chamber, the seminal vesicle (fig. 49, *b*), called seminal duct by von Graff (1899), who found a similar condition in *Geoplana marginata* F. Müller, 1858. *Geoplana cameliae* Fuhrmann, 1914a, also has a seminal vesicle external to the penis papilla, much like that of *G. montana*. As a rule, the seminal vesicle in planarians is inside the penis bulb, but these species lack a definite penis bulb. The seminal vesicle of *G. montana* is lined by a ciliated epithelium and in the paratype is surrounded by a halo of eosinophilous glands opening into it; at its anterior end it receives the two vasa deferentia. The female atrium, of elongated-funnel form (fig. 49, *b*), extends posteriorly from the common atrium; it lacks any special muscular thickening and hence is not regarded as a vagina. At its posterior end, the female atrium continues into the glandular duct ("Drüsengang" of German workers), which curves ventrally as a tube into whose lower end the two oviducts open. Genital atrium lined by a very tall extremely glandular epithelium, particularly well developed in the female atrium, where in the most mature specimen (the paratype) it is thrown into villuslike folds. Toward the male atrium the epithelium gradually diminishes in height and after turning to cover the penis papilla soon flattens down to the cuboidal epithelium of the latter (fig. 49, *c*); at the genital pore the epithelium is continuous with the rhabdite-containing body epithelium, here also very tall. Free ends of atrial epithelium filled with granules (fig. 49, *d*) staining blue in Mallory's connective tissue stain, hence probably mucous in nature; their source could not be determined, as no gland cells were seen in the adjacent parenchyma. Outside the atrial epithelium is a somewhat indefinite muscle layer continuous with the parenchymal fibers, best developed in the female atrium and diminishing toward the base of the penis. Glandular duct lined by a tall columnar epithelium interspersed with the outlets of the innumerable gland cells, which in the paratype form an immense halo around the duct and also extend into the parenchyma some distance posterior to the duct; gland cells of both cyanophilous and eosinophilous types. Gland cells also accompany the terminal portions of the oviducts.

Locality.—Type and young immature specimen collected at Coronado, Costa Rica, at 1,600 meters, by S. Rafael, April 12, 1935. Paratype collected at Volcán Barba, Costa Rica, at 2,800 meters, by M. Valerio, January 31, 1929. Fourth specimen, in bad condition, considered probably the same species, collected at San José, Costa Rica, 1,160 meters, by M. Valerio, no date, probably 1929.

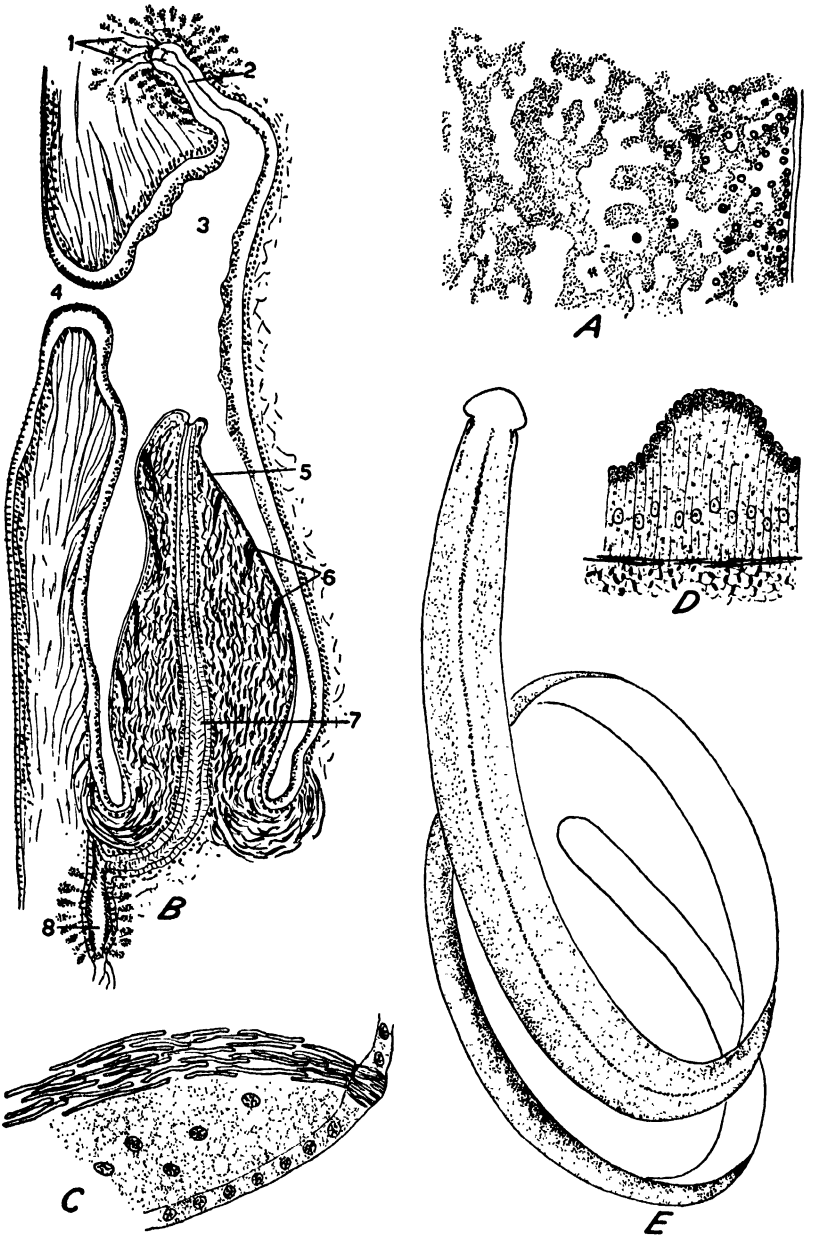


FIGURE 49.—New species of GEOPLANA and BIPALIUM

a–d, Geoplana montana: a, Small portion of lateral half, showing color pattern and eye arrangement; *b,* sagittal view of the copulatory apparatus, combined from type and paratype; *c,* small portion of the penis papilla, showing epithelium and one of the muscle bundles; *d,* atrial epithelium with granular tips.

e, Bipalium costaricensis: Type specimen.

1, Oviduct entrance; *2,* glandular duct; *3,* female atrium; *4,* common genital pore; *5,* penis papilla; *6,* muscle bundles of penis; *7,* ejaculatory duct; *8,* external seminal vesicle with gland cells.

Type.—U.S.N.M. no. 20407, including serial sections of postpharyngeal region. Paratype, U.S.N.M. no. 20408, including serial sections of postpharyngeal region.

Remarks.—*Geoplana montana* is seen to be an inhabitant of mountain regions in Costa Rica. Its collection in three different localities, at different times and by different collectors, indicates that the species must be relatively common. It is closely related and very similar in sexual anatomy to *Geoplana cameliae* Fuhrmann, 1914a, found at 1,400–1,800 meters in the central Cordilleras of Colombia. It differs from this species in color pattern, eye distribution, greater muscularity of the penis papilla, and much better development of the glandular duct. It is a question whether *G. montana* should not be regarded as a geographical variety of *G. cameliae*, but on present knowledge it seems best to make a separate species of it. One is forced to place considerable weight on differences in color pattern, because of the many similarities in general structure and sexual anatomy between the numerous species of *Geoplana*.

Family BIPALIIDAE

Genus BIPALIUM Stimpson, 1857

BIPALIUM COSTARICENSIS, new species

FIGURES 49, *e*; 50, *a*

Material examined.—Two specimens, both asexual.

Description.—Type, over 100 mm long (much coiling of the body made it impossible to get the exact length); paratype, about 80 mm long; width anteriorly, 3 mm. One of the long, slender species of *Bipalium*. Head 4 mm wide, typical of the genus. Arrangement of the eyes on the head shown in figure 50, *a*, dorsal surface to the right, ventral to the left. Behind the head, the body first widens slightly, remains of this width for about the anterior third of the body, then gradually diminishes to the rounded posterior end.

Color.—There is a very narrow middorsal black line that gradually disappears posteriorly; to either side of this the drab background gradually takes on a dark-brown color, which increases to the lateral margins. Posteriorly also the dark-brown color gradually intensifies until the posterior fourth of the body is a dark brownish black, slightly lighter toward the median region. Color descriptions based on alcoholic specimens several years old are, of course, not very reliable, but both specimens give the same impression as to color shades and pattern, although one is much more faded than the other. The latter, selected as the type, appears not to have suffered much loss of color. Ventral surface drab, with the midventral creeping ridge typical of the genus.

Sections of the postpharyngeal region of both specimens failed to show any trace of sex organs. The specific diagnosis therefore rests on shape and color pattern.

Locality.—Type and paratype collected at San José, Costa Rica, at 1,160 meters, by M. Valerio, June 15, 1929.

Type.—U.S.N.M. 20409, including serial sections of pharynx and adjacent region. Paratype, U.S.N.M. no. 20410, including also a piece removed for sectioning.

Family RHYNCHODEMIDAE

Genus RHYNCHODEMUS, Leidy, 1851

RHYNCHODEMUS TERRESTRIS (O. F. Müller, 1774)

FIGURE 50, *b*, *c*

Material examined.—A single specimen.

Description.—Specimen 12 mm long, cylindroid, both ends rounded, anterior end larger than posterior (fig. 50, *b*), this probably the result of contraction. Eyes not seen in the whole specimen but found in sections as a pair at the anterior tip. Cut into sagittal serial sections, but through the mistake of trying to stain the slides before the sections were fully dried the series was badly damaged. Sufficient remains, however, to enable one to reconstruct the copulatory apparatus.

Reproductive system.—The genital system was found to be so nearly identical with that of the European *Rhynchodemus terrestris* that after some indecision the specimen is placed in that species. The slight differences found are probably the result of various degrees of contraction and do not seem to warrant the erection of even a variety. Sagittal view of the copulatory apparatus is shown in figure 50, *c*. Genital pore communicates with genital atrium by a long canal; genital atrium occupied by the penis. Penis with well-developed bulb and papilla; papilla and bulb more elongated and slender than shown in figures of European specimens (e. g., by Bendl, 1908), but this probably is the result of a greater extension. Penis and bulb extremely muscular with a longitudinal muscle layer under the flattened epithelium of the papilla; bulb with numerous strong transverse fibers, appearing like a network. Each vas deferens enlarges slightly near the penis bulb to an external seminal vesicle, then narrows again, and enters the bulb where both join an elongated seminal vesicle lined by a high glandular epithelium. In European specimens this internal seminal vesicle is figured as a large rounded sac; in the present specimen it is elongated, but this again is referable to the extended state of the penis. In the penis papilla, the seminal vesicle narrows to an ejaculatory duct lined by a flat epithelium, which proceeds to the penis tip. Floor and rear of genital atrium lined by a very high

epithelium underlain by an indistinct muscularis, of inner circular and outer longitudinal fibers. From just behind the genital canal leading to the genital pore, the female canal starts and proceeds straight posteriorly, then widens into a chamber, which receives the two oviducts. The proximal part of this female canal is called vagina by Bendl (1908), but as it has no special musculature it is best regarded as a glandular duct. Gland cells were not evident in the present specimen; Bendl figures many opening into the duct. From the chamber that receives the oviducts, a tube runs anteriorly again,

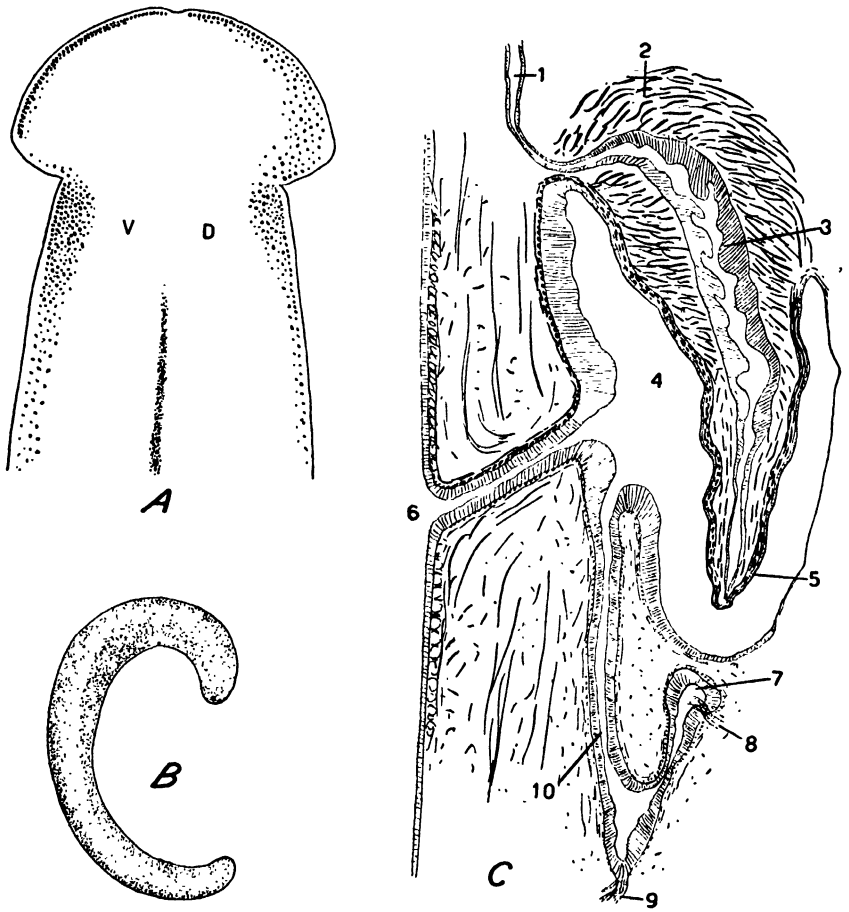


FIGURE 50.—Species of BIPALIUM and RHYNCHODEMUS

a, *Bipalium costaricensis*, new species: Showing eye arrangement—left half (V) is ventral surface, right half (D) is dorsal surface.

b, *c*, *Rhynchodemus terrestris* (O. F. Müller): *b*, Wisconsin specimen, side view; *c*, sagittal view of copulatory complex.

1, External seminal vesicle of vas deferens; *2*, penis bulb; *3*, internal seminal vesicle in penis bulb; *4*, male atrium; *5*, penis papilla; *6*, genital pore; *7*, seminal bursa (so-called uterus); *8*, genito-intestinal duct from same to intestine; *9*, entrance of oviducts; *10*, glandular duct.

widening into a sac very near the wall of the genital atrium. This diverticulum is called uterus by some authors, seminal receptacle by others; it is probably actually a copulatory bursa. In *R. terrestris* it gives off a pair of genito-intestinal ducts connecting with the adjacent intestine, one on each side. These ducts were seen in the present specimen but owing to the damage to the sections could not be traced into the intestine. Glandular duct and seminal receptacle are lined by a tall epithelium probably ciliated.

Color.—Jet black, uniform.

Locality.—In rotten wood in woods near Oconomowoc, Wis.; collected in July 1927, by Cahn.

Remarks.—This is the third land planarian, all species of *Rhynchodemus*, to be found in the United States. The other two, *R. sylvaticus* (Leidy, 1851) and *R. atrocyaneus* Walton, 1912, are presumably endemic, although so imperfectly known that it is difficult to draw conclusions about them. A study of serial sections of the copulatory apparatus is badly needed. At first the present specimen was thought to be a new species, but study of the copulatory apparatus revealed no good grounds for separating it from *R. terrestris*. The best figure of the copulatory apparatus of European specimens is that of Bendl (1908). As already remarked, the Wisconsin specimen differs from this figure in the following respects: Long genital canal between genital pore and atrium; more elongated penis papilla and seminal vesicle; and different shape of the seminal receptacle. These differences, however, seem to result from a less contracted condition of the parts than in Bendl's figure and do not appear to justify the creation of a new species or subspecies, especially as the European specimens vary considerably in color and sexual anatomy. In view of the wide distribution of *R. terrestris* in a variety of localities in Europe, its invasion into the United States is perhaps not surprising.

Order POLYCLADIDA

Suborder ACOTYLEA: Section SCHEMATOMMATA

Family LEPTOPLANIDAE

Genus LEPTOPLANA Ehrenberg, 1831 (emend. Bock, 1913)

LEPTOPLANA VESICULATA, new species

FIGURE 51

Material examined.—One specimen.

Description.—Specimen 22 mm long, 11 mm wide. Of general oval form (fig. 51, *a*), with ruffled edges, hence somewhat contracted, with the typical appearance of a leptoplanid. No tentacles, eyes in usual four clusters, paired rounded tentacular clusters of about 40–45 eyes, and paired elongated cerebral clusters of about 70–80 eyes. Pharynx of typical ruffled leptoplanid type, central, encircled by the uterus packed with eggs (fig. 51, *a*); mouth posterior to center but contraction of the specimen may have altered its true position.

Color.—Indeterminate, on account of long sojourn in alcohol, probably consisting of brown flecks dorsally.

Reproductive system.—Male apparatus shortly behind the pharynx, female pore shortly behind the male pore; genital sucker present between male and female pores (fig. 51, *b*). Postpharyngeal portion of specimen removed and sectioned serially; found to be in full sexual maturity. Sexual apparatus characteristic of the genus *Leptoplana* (sensu stricto, Bock, 1913) but with a Lang's vesicle absent in the type species of the genus. Sagittal semidiagrammatic view of copulatory apparatus shown in figure 51, *b*. The male genital pore leads into a vertical tubular cavity, the antrum masculinum, which, as in the type species [*L. tremellaris* (Müller, 1774)], is provided with a fold, termed by Bock the penis sheath. The portion of the antrum dorsal to this fold is called by Bock the penis pocket. At its dorsal termination it has the penis papilla, here very slightly developed, even less so than in *L. tremellaris*. From the penis the male duct continues dorsally as a tube considered by Bock to represent the granule vesicle; no glands entering this tube are evident in the present specimen. At its upper end the granule vesicle (if such it be) has the same lateral diverticulum found in *L. tremellaris*. The male duct now turns sharply forward as a slightly expanded tube, then bends dorsally again to enter the seminal vesicle. This is a highly muscular rounded mass composed chiefly of circular fibers. It contains a tubular cavity, slightly enlarged to a little rounded chamber where the common vas deferens enters from behind. The two vasa deferentia appear

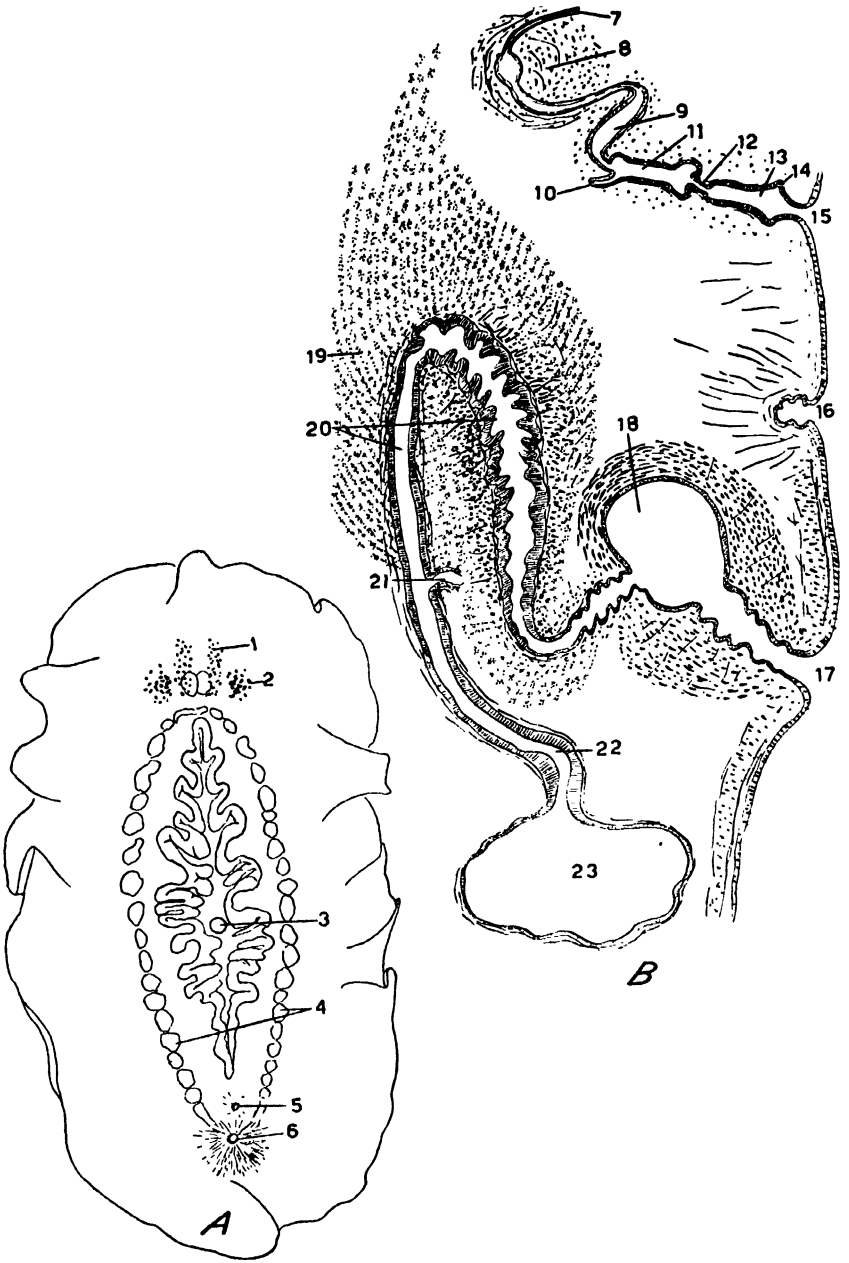


FIGURE 51.—LEPTOPLANA VESICULATA, new species

a, Type.

b, Sagittal view of copulatory complex.

1, Cerebral eyes; *2*, tentacular eyes; *3*, mouth; *4*, uterus; *5*, male pore; *6*, female pore; *7*, vas deferens; *8*, seminal vesicle; *9*, duct from seminal vesicle to granule vesicle; *10*, proximal diverticulum of granule vesicle; *11*, granule vesicle; *12*, penis; *13*, penis pocket; *14*, penis sheath; *15*, male pore; *16*, genital sucker; *17*, female pore; *18*, bulbous vagina; *19*, cement glands of glandular duct; *20*, glandular duct; *21*, entrance of common uterine duct; *22*, stalk of Lang's vesicle; *23*, Lang's vesicle.

to unite to a common duct before entering the seminal vesicle. Apart from the very muscular seminal vesicle, the male duct is but slightly muscular encircled by sparse circular fibers. It is lined by a low cuboidal epithelium, which is very granular from the beginning of the granule vesicle to the male pore. Between the male and female pores is the small bowl-shaped invagination of the genital sucker lined by a granular epithelium and showing some concentration of dorsoventral parenchymal muscle fibers. The female apparatus, in contrast to that of *L. tremellaris*, is very strongly developed. The female pore, situated on an elevation, leads into a large vagina with thick muscular walls, the fibers chiefly circular, and a granular epithelial lining. The upper end of the vagina is widened into a large sac-like cavity from the posterior wall of which springs the glandular duct (Kittdrüsengang of Bock, 1913). This type of vagina in Bock's terminology would be a bulbous vagina. The glandular duct is a large tube running forward and then backward in the sagittal plane, having thus a V-shape. It is lined by an epithelium of tall slender cells outside of which there is a considerable muscular investment, mostly of circular fibers with a few longitudinal ones next the epithelium. The glandular duct receives a tremendous array of long-necked eosinophilous gland cells, which occupy the parenchyma around the whole course of the duct and extend for long distances in all directions. These glands are the shell glands of early authors but are now generally designated cement glands (Kittdrüsen) and no doubt secrete the adhesive material in which the eggs are imbedded on laying. At its proximal end the glandular duct receives on its ventral side the very short common uterine duct which almost at once divides into the two uteri; these proceed forward one on each side of the pharynx (fig. 51, *a*) as wide, thin-walled, coiled canals stuffed with eggs. Behind the entrance of the uterine duct the female canal continues as a duct, which after proceeding posteriorly for some little distance widens into a large sac, Lang's vesicle in Bock's terminology. The duct between this vesicle and the entrance of the uterine duct is thus the stalk of Lang's vesicle. In the type species, *L. tremellaris*, Lang's vesicle is reduced to a slight protuberance beyond the uterine duct.

Locality.—Under rock, Mount Doughty, Puget Sound, Wash., collected on July 15, 1927, by Everett E. Wehr.

Type.—Anterior three-fourths as preserved specimen, U.S.N.M. no. 20411, including serial sections of postpharyngeal region.

Remarks.—In his classical revision of the polyclads, Bock (1913) has accepted Lang's opinion that *Leptoplana tremellaris* (O. F. Müller, 1774) is the first species to be ascribed to the genus *Leptoplana*, and the diagnosis of the genus must then be based on *L. tremellaris*,

of which Bock figures the copulatory apparatus. Unfortunately, *L. tremellaris* differs markedly in its sexual anatomy from the great majority of the many species that have been put into *Leptoplana* in the hundred years since the genus was founded, and so it becomes necessary to allocate practically all the older *Leptoplana* species to other genera. Most of them belong in *Notoplana* Laidlaw, 1903. Bock does not list any other species but *tremellaris* under *Leptoplana*. The present species, *L. vesiculata*, clearly belongs in *Leptoplana* and justifies the concept of a leptoplanid genus built around *L. tremellaris*. The distinguishing features of the genus are the wide separation of the genital pores with a genital sucker between them, the well-developed seminal vesicle, the tubular, poorly differentiated granule vesicle without definite external limitation, with a proximal diverticulum, and the small unarmed penis in a long penis pocket. Since *L. vesiculata* has a large Lang's vesicle, Bock's definition of *Leptoplana* (1913, p. 181) must be emended to read: "Lang's vesicle developed or rudimentary."

The only previous publication on the polyclads of the Puget Sound region is that of Freeman (1933). He does not list any species of *Leptoplana*, and it is obvious that *L. vesiculata* is not identical with any of the species he describes. Polyclads from the California coast have been studied by Plehn (1896, 1898), Heath and McGregor (1912), Boone (1929), and Freeman (1930). Bock has transferred Plehn's *Leptoplana californica* to the genus *Stylochoplana*. Heath and McGregor describe four new species of "*Leptoplana*." Of these, *L. rupicola* probably belongs to *Notoplana*, *L. timida* is probably not a *Leptoplana*, since it has a large penis and definite granule vesicle, *L. saxicola* is evidently a *Notoplana*, and *L. inquieta* with its common genital pore would also not fit into *Leptoplana*. Boone (1929) figures "*Leptoplana*" *sciophila* with a chambered granule vesicle (whose nature she failed to understand), and hence this species is either a *Stylochoplana* or a *Notoplana*. "*Leptoplana*" *acticola* is also stated by Boone to have a large granule vesicle (which she calls ejaculatory organ and figures badly), and it must therefore be removed from *Leptoplana*. After all that has been said by the foremost students of the Turbellaria on the absolute necessity of a study of serial sections in the taxonomy of this group, there appears to be no excuse for the further publication of taxonomic descriptions based only on whole mount studies. These California forms must be restudied before they can be allocated to the proper genera.

It thus appears that *Leptoplana vesiculata* is the only member of the genus so far found on the Pacific coast of the United states. Old descriptions of *Leptoplana* species from the Atlantic coast cannot be evaluated until the specimens are reexamined.

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ECHINODERMS OF THE SMITHSONIAN-HARTFORD EXPEDITION, 1937, WITH OTHER WEST INDIAN RECORDS

By Austin H. Clark

The Smithsonian-Hartford Expedition in the ship *Joseph Conrad*, made possible through the interest and generosity of George Huntington Hartford, 3d, between March 15 and May 12, 1937, visited the Bahamas, Haiti, Puerto Rico, St. Thomas, St. John, St. Croix, Saba, St. Eustatius, Dominica, Martinique, Barbados, Jamaica, and Cuba. The naturalists on this expedition were Dr. Waldo L. Schmitt, curator of the division of marine invertebrates, United States National Museum, and G. Robert Lunz, of the Charleston, S. C., Museum.

The collection of echinoderms brought back was an unusually interesting one, including excellent series of the young of various species, and no less than three new species of ophiurans, two of which were recently described by Dr. Hubert Lyman Clark. The discovery of three new ophiurans in a region so well known as the Caribbean area shows how intensively and systematically the arduous work of shore collecting in the Tropics was carried on by Dr. Schmitt and Mr. Lunz.

A list of the Smithsonian-Hartford, *Albatross*, and *Fish Hawk* stations mentioned herein is given at the end of this paper.

ASTEROIDEA

ASTROPECTEN ANTILLENSIS Lütken

Localities.—Smithsonian-Hartford station 10, Bahamas (1, E. 5428). Station 26, St. Thomas (1, E. 5580).

ASTROPECTEN ARTICULATUS (Say)

Locality.—*Albatross* station 2420, Virginia, off Cape Charles (1, 18334).

ASTROPECTEN ARTICULATUS var. VALENCIENNESI Müller and Troschel

Locality.—Texas, Clyde T. Reed (1, E. 5228).

LUIDIA CLATHRATA (Say)

Localities.—Smithsonian-Hartford station 19, Puerto Rico (arm, E. 5478). *Albatross* station 2016, Virginia, off Accomac County (1, 6372). *Albatross* station 2017, Virginia, off Accomac County (1, 6273). *Fish Hawk* station 8369, Chesapeake Bay (1, E. 1181). Texas, Clyde T. Reed (2, E. 5229).

LUIDIA SENEGALENSIS (Lamarck)

Locality.—Smithsonian-Hartford station 19, Puerto Rico (2, E. 5582).

NOTES.—Both the specimens have 9 arms. In the larger R=145 mm, and in the smaller R=70 mm.

OREASTER RETICULATUS (Linnaeus)

Locality.—Smithsonian-Hartford station 28, St. John (1, E.5415).

OPHIDIASTER GUILDINGII Gray

Locality.—Smithsonian-Hartford station 28, St. John (1, E.5453).

LINCKIA GUILDINGII Gray

Localities.—Smithsonian-Hartford station 12, Haiti (4, E.5429, E.5430, E.5447). Station 28, St. John (4, E.5432, E.5433, E.5434). Station 56, Barbados (1, E.5431). Station 68, St. Thomas (2, E.5477).

NOTES.—Two of the specimens from station 12 have 6 arms, the larger with R=80 mm. Another has 5 arms with R=80 mm. The last is a comet with 1 long arm and 5 short arms. Of the specimens from station 28 two have 6 and two have 5 arms. The specimen from station 56 and both of those from station 68 have 6 arms. Thus, of the 11 specimens collected eight have 6 and three have 5 arms.

THYRASTER SERPENTARIUS (Müller and Troschel)

Locality.—Off Tampa Bay, Fla., James E. Benedict, 1901 (1, 36995).

FREYELLA MEXICANA, new species

Characters.—Disk 11 mm in diameter; 6 stout arms only slightly swollen in the genital region, 110+ mm long; disk covered with a pavement of small plates, each with a single spinelet; genital region uniformly covered with larger plates each with usually 2 to 4 similar spinelets, more or less in a transverse series; no papulae; pedicellariae numerous on disk and arms; mouth plates large, the aboral ends of each pair separated by a small plate and supporting the large circular azygous interradial; each mouth plate with 9 to 12 spines; first two

adambulacral plates united by syzygy; proximal adambulacrals with a diagonal row of 4 or 5 spines; marginals greatly reduced, widely separated.

Description.—The disk is 11 mm in diameter, with the borders between the broad arm bases straight and only about one-quarter as long as the width of the arm bases. The surface is flat and on the same level as that of the abactinal surface of the rays, which is continuous with it.

The disk is completely covered with a pavement of small subequal contiguous polygonal plates, each of which bears a single (more rarely two) long, slender, sharp, roughened or subechinulate spinule. Thickly strewn over the surface of the disk, with a tendency to congregate about the spinules, are numerous very small pedicellariae the tips of which are much broadened, rounded-triangular, with a smooth and straight or slightly concave distal border. When the pedicellariae are open the long processes at the base of each blade extending laterally give them the appearance of having 4 blades, 2 spatulate and 2, at right angles to these, pointed.

In each of the interbrachial angles is a large, circular, swollen interradial that extends from the abactinal surface halfway to the actinal and occupies the entire interval between the arm bases. Beneath this are two large contiguous plates representing abactinal extensions of the mouth plates, which, like the interradial, span the interval between the arm bases. Immediately below the interradial is a small plate lying between the abactinal ends of the two mouth plates and with difficulty distinguishable from them.

The madreporite is rather large, 1.3 mm in diameter, situated at about its own diameter from the adjacent interradial plate, strongly convex, and bare of spines. The opening is a rather broad oval slit crossed by a few delicate calcareous bridges situated on one side.

The anus is rather large and conspicuous, excentric, 4.7 mm from the edge of the disk.

The 6 arms are 110+ mm long, stout at the base, with a rather slight fusiform swelling over the genital region, becoming slender distally. They are 3.8 mm wide at the base, 5.5 mm wide in the broadest part, about 11 mm from the disk; and the genital region, beyond which there are no abactinal plates, is 24 mm long, or a little more than twice the diameter of the disk. The arms are broad actinally, narrow abactinally, with sharply sloping sides.

The genital region is completely enclosed by a continuous pavement of rather large rhombic, pentagonal, or hexagonal contiguous plates, which are usually slightly broader than long. These plates show no indication of arrangement in transverse bands, and each bears in its central portion 1 to 4 or 5 (usually 2 to 4) well-separated spinules resembling those on the disk. On a few of the plates at the

arm base there may be as many as 6 or 7 spinules, and in the distal portion of the genital region the number is usually one. Though commonly irregularly grouped, these spinules show a tendency to become aligned in a transverse row. On the surface of the plates in the vicinity of the spinules are more or less numerous very small pedicellariae resembling those on the disk.

The delicate membrane covering the abactinal surface of the arms beyond the genital region carries numerous scattered pedicellariae resembling those on the disk. These seem to have no regular arrangement.

The actinostome is 6.3 mm in diameter. The mouth plates are triangular, with the interradial (longest) apposed sides straight, the aboral side obtusely notched, and the radial side obtusely angled where the actinostome joins the ambulacral groove. The actinostomal border bears 3 subequal slender spines. Just beyond these, at the junction of the actinostome and the ambulacral groove, is a small lobate projection of the mouth plate on which are situated 2 (rarely 3) spines, the one next to the ambulacral groove resembling the spines just noticed, the other (or others) smaller. Near the distal end of the plate on the side adjoining the ambulacral groove are 2 (rarely 3) additional spines smaller than those previously mentioned and situated at some distance from them. In about the middle of the mouth plate, halfway between the long interradial side and the opposite angle, is a large stout spine roughly twice as long as the others mentioned, and between this and the outer angle of the plate adjoining the ambulacral groove is another spine, about two-thirds its size. Near the angle between the long interradial side and the distal margin of the mouth plate there may be another small spine. All the spines are enclosed in skin sacks, which bear numerous very small pedicellariae.

The first adambulacral plates are about half again as broad as long, the second are somewhat longer than their median width, and those following increase in length, those in the genital region being somewhat longer than the width of the proximal end or slightly longer, and the outer being about twice as long as the width of the proximal end or even longer. All are strongly concave on the side toward the ambulacral groove. The ambulacral groove, which at first is rather broad, narrows distally, the adambulacrals finally meeting in the midline so that the tube feet are arranged in widely separated pairs.

The first two adambulacral plates are united by a syzygy with a small ligament mass visible halfway between the median line and the border of the ambulacral groove.

The first adambulacral plate bears a long spine, about half again as long as itself, in the median line (as viewed actinally) about one-third of the distance from the proximal to the distal end. Near the distal inner angle of the plate adjoining the ambulacral groove is a furrow spine about two-thirds the length of the plate. Between this and the large central spine, forming all together a diagonal row of 4 spines, are 2 other spines of which that nearest the furrow spine is a little smaller than the latter, and that near the median spine is larger, about half as large as the median spine.

The second adambulacral plate has a similar diagonal row of 4 spines, but the large median spine is situated slightly more distally, at or slightly beyond the middle of the ossicle.

The third adambulacral plate has a diagonal row of 5 spines of which the 3 inner are subequal, small, and slender, the next is larger and stouter, and the outermost, in the center of the plate, is half again as long and much stouter.

The fourth and fifth adambulacral plates have each a similar row of 5 spines.

On the seventh adambulacral another spine appears, a long spine half again as long as the plate situated on the outer side just at the edge of the plated abactinal covering of the arm base, and just beyond the large central spine. This spine is absent from the eighth adambulacral but occurs on the ninth and twelfth and distally on alternate adambulacrals.

On the outer adambulacrals the long central spine becomes separated from the others; the latter also become smaller, forming a diagonal line of 4 small sharp spines at the distal angle of the plate.

On the distal portion of the arm the furrow spines become reduced to three, then to two, and finally to one.

All the spines are enclosed in skin sacks, which bear numerous minute pedicellariae.

The adambulacral plates are widely spaced.

The marginals are very small, less than half as long as the adambulacrals. They adjoin the distal outer angle of an adambulacral and run distally along the edge of the ambulacral, overlapping the base of the adambulacral following for about one-third of its length. They are thus widely separated from each other.

There are no papulae on the disk or on the arms.

Type.—From *Albatross* station 2379, Gulf of Mexico (U.S.N.M. no. E.5602).

Remarks.—Heretofore the family Brisingidae was known to be represented in the Caribbean region only by *Hymenodiscus agassizii* E. Perrier, from off St. Croix and Dominica in 391–450 fathoms, and *Odinia antillensis* A. H. Clark, from off Puerto Rico in 280–340 fath-

oms. *Freyella mexicana* is the first species to be reported from the Gulf of Mexico.

Although in *Freyella mexicana* the first two adambulacrals are united by syzygy, the marginals are greatly reduced and do not bear spines, the number of spines on the mouth plates and on the adambulacrals is exceptionally large, and directly beneath the prominent interradial there is a small plate that separates the upper ends of the two mouth plates of each pair, it does not seem to me that it differs sufficiently from related species to justify the creation of a new genus for its reception.

The other 6-rayed species of *Freyella* are: *Freyella sexradiata* E. Perrier from west of northern Spain in 2,255 fathoms; *F. tuberculata* Sladen, from between the Canary and Cape Verde Islands, between Ascension Island and the African coast, and the eastern tropical Pacific in 2,222–2,400 fathoms; *F. benthophila* Sladen, from the central south Pacific in 2,550 fathoms; and *F. oligobrachia* H. L. Clark, from the eastern tropical Pacific in 2,222–2,320 fathoms. All these differ from *F. mexicana* in having the first two adambulacrals articulated instead of being united by syzygy; in having the marginals with spines, at least on alternate plates; in lacking the small unpaired interradial plate between the upper ends of the mouth plates of each pair; in having the mouth plates with 2 to 4 spines instead of 9 to 12; and in having the adambulacrals with 1 or 2 spines instead of 4 or 5.

In certain respects *Freyella mexicana* suggests *Colpaster scutigerula* Sladen, from southwest of the Canary Islands in 1,525 fathoms. In this species the first two adambulacrals are united by syzygy; the mouth plates have 6 spines, and the adambulacrals have 4 or 5 spines; and there is an unpaired plate just below the interradial plate as in *F. mexicana*, but this is much larger and separates the first adambulacral plates instead of the upper ends of the mouth plates. In *Colpaster* the plates of the disk bear stout stumps ending in 4 or 5 radiating thorns instead of spinelets as in *Freyella mexicana*.

OPHIUROIDEA

OPHIOMYXA FLACCIDA (Say)

Localities.—Smithsonian-Hartford station 12, Haiti (1, E. 5471). Station 28, St. John (2, E.5474).

HEMIPHOLIS ELONGATA (Say)

Localities.—Smithsonian-Hartford station 19, Puerto Rico (3, E.5473). Station 20, Puerto Rico (1, E.5593).

OPHIOSTIGMA ISACANTHUM (Say)

Locality.—Smithsonian-Hartford station 17, Puerto Rico (1, E.5448).

AMPHIODIA GYRASPIS H. L. Clark

Locality.—Smithsonian-Hartford station 19, Puerto Rico (4+, E.5454, E.5455, E.5456).

OPHIACTIS NOTABILIS H. L. Clark

Ophiactis notabilis H. L. Clark, Proc. U. S. Nat. Mus., vol. 86, p. 415, pl. 52, figs. 1, 2, 1939.

Locality.—Smithsonian-Hartford station 19, Puerto Rico, (1, E.5590).

OPHIACTIS SAVIGNYI (Müller and Troschel)

Locality.—Smithsonian-Hartford station 19, Puerto Rico (6, E.5451).

OPHIOTHRIX ANGULATA (Say)

Localities.—Smithsonian-Hartford station 12, Haiti (3, E.5399, E.5400, E.5401). Station 15, Haiti (1, E.5398). Station 19, Puerto Rico (7, E.5395, E.5396). Station 21, Puerto Rico (11, E.5397, E.5407, E.5416). Station 23, St. Thomas (4, E.5404, E.5405, E.5406). Station 50, Martinique (2, E.5403). Station 55, Martinique (5, E.5402).

Notes.—One of the specimens from station 12, Haiti (E.5400), is white with the radial shields, except for the outer and inner ends, violet; the arms are sprinkled with small irregular black dots, and bear interrupted light violet cross bands at about every fourth pair of side arm plates. Another specimen from station 12 (E.5401) has the disk violet with broad light lines on the outer side of the radial shields and central white marks; the upper and side arm plates are violet and white. As in the preceding specimen, there is no median line on the arms. A specimen from station 19, Puerto Rico (E.5395), has the arms with frequent narrow cross bands and no median stripe.

OPHIOTHRIX SUENSONII Lütken

Locality.—Smithsonian-Hartford station 55, Martinique (4, E.5409, E.5410, E.5411).

OPHIOTHRIX ÖRSTEDII Lütken

Localities.—Smithsonian-Hartford station 12, Haiti (11, E.5417). Station 17, Puerto Rico (1, E.5412). Station 27, St. John (1, E.5413). Station 28, St. John (1, E.5414).

OPHIOTHRIX HARTFORDI, new species

Plate 53, Figures 1, 2

Description.—The disk is 4.3 mm in diameter, flat, pentagonal, with broadly rounded interradial angles. The sides of the pentagon, crossing the arm bases, are straight or slightly concave. The greater

part of the surface of the disk is occupied by 5 pairs of large radial shields. The two shields of each pair are separated by a single somewhat irregular row of moderate-sized obscurely delimited scales. The pairs of shields are separated interradially by about 3 rows of scales with similarly indefinite borders. The scaled central portion of the disk, a circular area with a diameter equal to about one-fourth that of the disk, the narrow radial line of scales, and the broad interradial bands are uniformly studded with short, thick, subconical stumps with blunt spinulose tips that on superficial examination appear like granules. In the central circular area there are about 40 of these; a single somewhat irregular row runs along the lines of scales separating the radial shields of each pair; and there are about 3 irregular rows at the inner ends of the interradial bands of scales, this number increasing to about 6 at the edge of the disk. Each scale seems to carry a single stump. The radial shields bear 1 to 5 widely and irregularly scattered stumps. The interbrachial areas on the oral surface are naked except for 3 or 4 large, rounded, and well-defined scales in the central portion, one or two of which may bear centrally situated stumps.

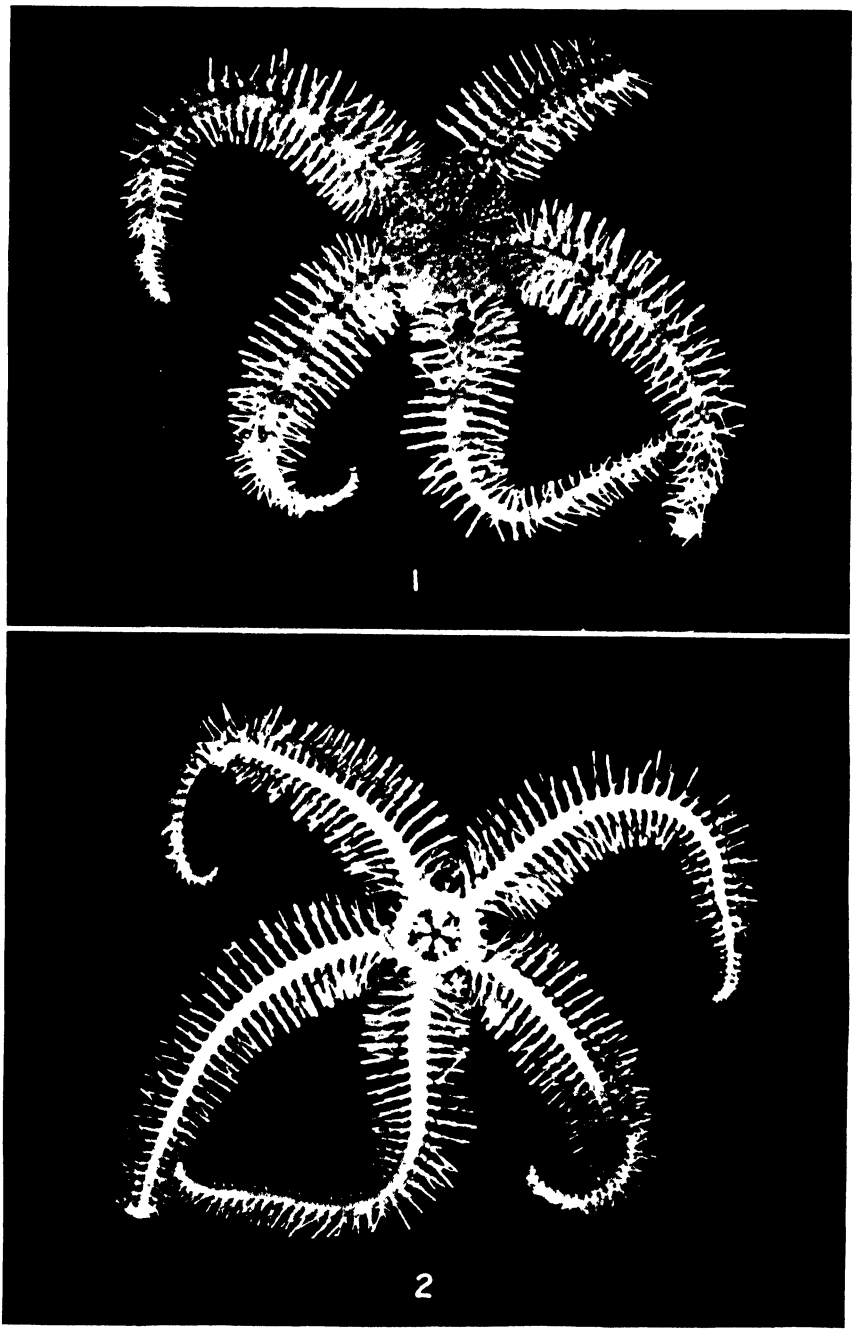
The 5 short arms are 13 mm long. The upper arm plates increase in size to the fourth, which is triangular with the proximal angle very broadly and the lateral angles more abruptly rounded, not quite twice as broad as long. The upper arm plates following gradually increase in length, the angle between the lateral edges at the same time decreasing, so that at the middle of the arm they are about as long as broad. Distally they become very narrow, elongate fan-shaped, much longer than broad, with rounded lateral angles, remaining always in contact. The surface of the upper arm plates is finely pustulate.

The oral shields are nearly twice as broad as long, rhombic with concave sides, the lateral angles rounded and the outer and inner angles pointed.

The adoral plates are triangular, about twice as long as the width of the radial ends, with their apices just meeting under the inner side of the oral shields. Their outer border is closely appressed to, and of the same length as, the adjoining side of the oral shield.

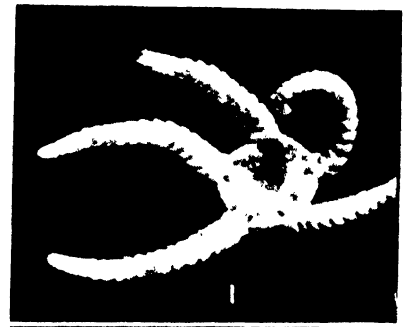
There are 9 rather short and stout tooth papillae, a column of 4 on each jaw plate and a median one.

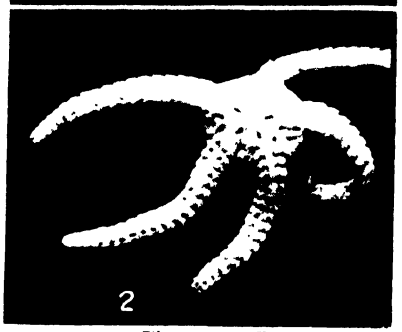
The under arm plates are quadrilateral with the proximal and distal angles rounded, the distal border strongly concave, and the proximal somewhat convex. They are at first broader than long, becoming about as broad as long in the middle of the arm and elongate distally. In the earlier portion of the arms the proximal border is more or less angulate centrally.



OPHIOTHRIX HARTFORDI, NEW SPECIES.

The type specimen (U. S. N. M. No. E. 5592) from station 16, Puerto Rico: Aboral (1) and oral (2) views. A young individual is visible in the lower right interbrachial angle, figure 2. × 5.











OPHIODERMA AND OPHIOCOMA.

1, 2, *Ophioderma brevicaudum*, *Ophiocryptus* stage, from station 12, Haiti (U. S. N. M. No. E. 5437), aboral (1) and oral (2) views; 3, *Ophiocoma pumila*, young, from station 28, St. John (U. S. N. M. No. E. 5559), aboral view; 4, *Ophiocoma echinata*, young, from station 15, Haiti (U. S. N. M. No. E. 5514), aboral view; 5, *Ophiocoma riisei*, young with naked disk, from station 17, Puerto Rico (U. S. N. M. No. E. 5522), oral view. All × 5.

The side arm plates are widely separated on the oral side of the arms; on the aboral side they extend inward for about one-third the width of the arm. The arm spines are borne on a high narrow crest.

There are 7 arm spines. The lowest arm spine is in the form of a stout hook with a long, slender, strongly recurved glassy tip beneath which is a long and slender supplementary point. The uppermost spine is short and more or less erect. The longest spine is the third, counting from the aboral surface. The second is intermediate in length between the first and the third, usually more nearly resembling the third. Aborally the spines rapidly decrease in length. The spines are rather slender, flattened, and rather strongly echinulate. They are rather short, the longest being only about one-third again as long as the width of the arm.

The single tentacle scale, situated in the angle between the under and side arm plate, is short, rhombic, not much longer than broad, with a finely spinous and more or less rounded tip. The first tentacle scale is on the third tentacle pore.

The color is light pearl gray, the arms above with narrow bands of darker on about each fourth joint. The spines and the oral surface are white.

Type.—Smithsonian-Hartford station 16, Puerto Rico, western end of San Juan Island in the vicinity of Fort San Geronimo; shore; W. L. Schmitt, March 27, 1937 (U. S. N. M. no. E. 5592).

NOTES.—The type specimen carries several young clinging to the ventral portion of the disk by means of the strongly developed hook representing the lowest arm spine. The skeleton of the young consists of a very large pentagonal central plate with a large primary radial extending outward from each of the five sides. There is a single prominent tubercle or stump in the middle of the inner border of each primary radial. From the angles of the central pentagon the sides of each radial converge to the arm base. The arms, as seen from above, consist of two upper arm plates and 2 pairs of side arm plates, and terminate abruptly in a small bud. The hook representing the lowest arm spine is well developed. Above the hook on the first side arm plate are two very short and very spiny rudiments of arm spines; there is only one of these on the second side arm plate.

OPHIOTHRIX PLATYACTIS H. L. Clark

Ophiothrix lineata A. H. CLARK, Univ. Iowa Studies in Nat. Hist., vol. 9, no. 5, p. 54, 1921 (off Pelican Island, Barbados, 4 fathoms).—H. L. CLARK, New York Acad. Sci., Scientific survey of Porto Rico and the Virgin Islands, vol. 16, pt. 1, p. 62, 1933 (possibly *O. suensonii*).

Ophiothrix platyactis H. L. CLARK, Proc. U. S. Nat. Mus., vol. 86, p. 417, pl. 52, figs. 3, 4, 1939.

Locality.—Smithsonian-Hartford station 56, Barbados (1, E. 5591.)

OPHIONEREIS RETICULATA (Say)

Localities.—Smithsonian-Hartford station 12, Haiti (1, E.5469). Station 15, Haiti (1, E.5470).

OPHIONEREIS SQUAMULOSA (Koehler)

Locality.—Smithsonian-Hartford station 12, Haiti (3, E.5466, E.5467, E.5468).

OPHIOCOMA ECHINATA (Lamarck)

PLATE 54, FIGURE 4

Localities.—Smithsonian-Hartford station 12, Haiti (20, E.5498, E.5499, E.5500, E.5501, E.5502, E.5503, E.5504, E.5505, E.5506, E.5507, E.5508, E.5509, E.5510, E.5511). Station 15, Haiti (2, E.5513, E.5514). Station 16, Puerto Rico (2, E.5484, E.5485). Station 17, Puerto Rico (5, E.5486, E.5487, E.5488, E.5489, E.5490). Station 23, St. Thomas (5, E.5493, E.5494, E.5495, E.5496, E.5497). Station 28, St. John (17, E.5479, E.5480, E.5481, E.5482, E.5483). Station 56, Barbados (5, E.5491, E.5492).

NOTES.—In the specimen from station 17, Puerto Rico (E.5522) (pl. 54, fig. 4) has the disk 4.5 mm in diameter and the arms 16.5 mm long. In an individual of this size there are 2 tentacle-scales in the proximal half of the arm, but only one in the distal half. The aboral surface of the disk is densely covered with small spinulose granules, which are somewhat higher than thick, but there are no granules on the oral surface. Five or six of the uppermost arm spines on each side of the basal portion of the arm, situated on alternate side arm plates beginning with the third, are much swollen and stand nearly vertically. The presence of 5 arms, granules on the disk, 2 tentacles scales in the proximal half of the arm, and markedly swollen upper arm spines make the young of this species easy to recognize.

OPHIOCOMA RIISEI Lütken

PLATE 54, FIGURE 5

Localities.—Smithsonian-Hartford station 12, Haiti (4, E.5515, E.5516, E.5517). Station 17, Puerto Rico (1, E.5522). Station 28, St. John (1, E.5520). Station 66, St. Thomas (3, E.5518, E.5519, E.5521).

NOTES.—In the specimen from station 17, Puerto Rico (E.5522) (pl. 54, fig. 5), the disk is 3.5 mm in diameter and the arms are about 15 mm long. There are no granules on the disk, which, except for its very dark color, recalls the disk of an *Amphiura*. The im-

bricating disk scales are of moderate size, but the radial shields are very small, oblong with rounded ends, two to three times as long as broad, and widely separated. They are situated on either side of the arm bases, and the two of each pair diverge inwardly. The lateral border of the disk between the arm bases is sharply keeled. The first tentacle pore carries 1, rarely 2, tentacle scales; those following have one only. The first side arm plate carries 2 arm spines, the second carries 3, and the third usually has 4; there are 3 arm spines on the side arm plates succeeding as far as the middle of the arm, beyond which the number drops to 2, with an occasional 3. In the proximal portion of the arm the uppermost arm spine is equal in length to about two arm joints, the lowest to one, with the middle arm spine intermediate. The arm spines are very slender. As the arm joints become longer distally the arm spines decrease in relative length, the upper soon equaling one and one-half arm joints with the lower somewhat shorter. Later the upper is only slightly longer than an arm joint. In the distal portion of the arm the two arm spines are of the same length, about as long as an arm joint. Terminally the upper arm spine decreases in length, finally becoming only about two-thirds the length of the lower. In color the disk is dark brown, the arms above light brown, the circumoral structures, spines, and lower surface of the arms white or slightly yellowish white. The naked disk and long and very slender arm spines easily distinguish the young of this species from the young of *O. echinata* and of *O. pumila.*

OPHIOCOMA PUMILA Lütken

PLATE 54, FIGURE 3

Localities.—Smithsonian-Hartford station 12, Haiti (33, E. 5526 to E. 5558). Station 16, Puerto Rico (1, E. 5560). Station 23, St. Thomas (2, E. 5563, E. 5564). Station 28, St. John (1, E. 5559). Station 56, Barbados (2, E. 5561, E. 5562).

NOTES.—The specimen from station 28, St. John (E. 5559) (pl. 54, fig. 3), has the disk 4 mm in diameter and the arms about 13 mm long. There are 6 arms, the 3 on one side slightly larger than the 3 on the other side. The granules aborally are high, twice as high as thick or higher, swollen-conical, and somewhat less densely placed than in larger examples. There are 4 arm spines until near the end of the arms, where the number falls to 3. Except for the possession of 6 arms, the young of this species more closely resemble the fully grown than do the young of *O. echinata* or *O. riisei.* The occurrence in this individual of two groups of 3 arms of different sizes suggests that autotomy may take place at least twice before the ultimate 5-armed stage is reached.

OPHIOPSILA RIISEI Lütken

Locality.—Smithsonian-Hartford station 12, Haiti (6, E. 5460 to E. 5465).

OPHIODERMA APPRESSUM (Say)

Localities.—Smithsonian-Hartford station 12, Haiti (1, E. 5419). Station 17, Puerto Rico (1, E. 5418). Station 27, St. John (1, E. 5425). Station 28, St. John (6, E. 5422 to E. 5424). Station 56, Barbados (1, E. 5420). Station 66, St. Thomas (1, E. 5421).

OPHIODERMA BREVICAUDUM Lütken

PLATE 54, FIGURES 1, 2

Localities.—Smithsonian-Hartford station 3, Bahamas (1, E. 5443). Station 12, Haiti (10, E. 5437, E. 5439, E. 5440). Station 15, Haiti (1, E. 5438). Station 17, Puerto Rico (5, E. 5441, E. 5445). Station 23, St. Thomas (1, E. 5442). Station 28, St. John (1, E. 5444). Station 33, St. Croix (1, E. 5436). Station 56, Barbados (2; E. 5435).

NOTES.—One of the specimens from station 12, Haiti (E. 5437) (pl. 54, figs. 1, 2), is in the *Ophiocryptus* stage. The disk is 2.7 mm in diameter and the arms are 5 mm long. The entire upper and under surface is uniformly covered with granules from which the mouth papillae and the short conical arm spines project. On some of the arms more or fewer of the upper arm plates show raised areas of various sizes bare of granules indicating the beginning of the transition to the adult form. The lateral areas between the arm bases are occupied by a single large somewhat swollen plate evenly covered, like the rest of both surfaces, with closely set granules. The color is uniform light and somewhat grayish green, lighter on the oral side.

OPHIODERMA CINEREUM Müller and Troschel

Locality.—Smithsonian-Hartford station 16, Puerto Rico (1, E. 5427).

OPHIODERMA RUBICUNDUM Lütken

Locality.—Smithsonian-Hartford station 68, St. Thomas (1, E. 5577).

OPHIOZONA IMPRESSA (Lütken)

Locality.—Smithsonian-Hartford station 4, Bahamas (E. 5472).

OPHIOLEPIS ELEGANS Lütken

Locality.—Smithsonian-Hartford station 55, Martinique (4, E. 5458, E. 5459).

OPHIOLEPIS PAUCISPINA (Say)

Localities.—Smithsonian-Hartford station 12, Haiti (1, E. 5475). Station 23, St. Thomas (1, E. 5457).

ECHINOIDEA

EUCIDARIS TRIBULOIDES (Lamarck)

Localities.—Smithsonian-Hartford station 3, Bahamas (1, E. 5586). Station 12, Haiti (6, E. 5578).

CENTRECHINUS ANTILLARUM (Philippi)

Localities.—Smithsonian-Hartford station 12, Haiti (1, E. 5452). Station 20, Puerto Rico (1, E. 5583).

NOTES.—The specimen from station 12 is small, with banded dark brown and white spines. In life the large specimen from station 20 was reddish, with pure white spines.

LYTECHINUS VARIEGATUS (Leske)

Localities.—Smithsonian-Hartford station 4, Bahamas (3, E. 5596). Station 20, Puerto Rico (1, E. 5584). Station 26, St. Thomas (6, E. 5579). Station 28, St. John (1, E. 5525).

NOTES.—The specimens from station 4 are 5–9 mm in diameter and white in color. The specimen from station 20 is white, with the spines in the 10 poriferous zones green; a narrow wavy red line runs down the middle of each interambulacrum. The largest specimen from station 26 is 76 mm in diameter.

TRIPNEUSTES ESCULENTUS (Leske)

Localities.—Smithsonian-Hartford station 3, Bahamas (3, E. 5585). Station 28, St. John (1, E. 5524). Station 33, St. Croix (3, E. 5523). Station 66, St. Thomas (2, E. 5588).

ECHINOMETRA LUCUNTER (Linnaeus)

Localities.—Smithsonian-Hartford station 9, Bahamas (3, E. 5383). Station 12, Haiti (31, E. 5389, E. 5390, E. 5391, E. 5426, E. 5446). Station 15, Haiti (1, E. 5408). Station 16, Puerto Rico (1, E. 5394). Station 17, Puerto Rico (5, E. 5392, E. 5393). Station 28, St. John (7, E, 5384, E. 5385, E. 5386). Station 38, St. Croix (1, E. 5575). Station 66, St. Thomas (2, E. 5387, E. 5388).

NOTES.—The specimens are all small, the smallest having a diameter of 3.4 mm (station 12, Haiti, E. 5389). In the smallest specimens the spines are whitish or light greenish with white tips and are conspicuously banded, having either one dark band just beyond the middle, or two dark bands at about the ends of the first and second thirds.

In the larger specimens the spines are usually dark brownish with an olive tinge, less commonly with a violet tinge. Rarely they are light drab, and occasionally they are more or less bright light olive

with abrupt and conspicuous deep violet tips (station 12, Haiti, E. 5391; station 28, St. John, E. 5384, E. 5386).

The spines vary somewhat in length, the longest sometimes almost equaling the lesser diameter of the test (station 28, St. John, E. 5385), though usually they are considerably shorter. Occasionally they are slender (station 28, St. John, E. 5385), and in one specimen (station 17, Puerto Rico, E. 5393) they are swollen and club-shaped—possibly a pathological condition.

CLYPEASTER ROSACEUS (Linnaeus)

Localities.—Smithsonian-Hartford station 3, Bahamas (1, E. 5587). Station 4, Bahamas (1, E. 5595).

NOTES.—The specimen from station 4 is small, 15.5 mm long and 13 mm broad.

MELLITA QUINQUIESPERFORATA (Leske)

Localities.—Cherrystone, Va., Col. Marshall McDonald, August 27, 1881 (60+, 4980, 5493, 30901). Hog Island, Virginia, William Stimpson (1, 3531). Smiths Island, Virginia, William Palmer, May 19, 1898 (1, 18974). Wallops Island, Virginia, A. A. Riggin (2, 32310).

NOTES.—Living examples of this species are very abundant at Cherrystone, Va., and are common locally at Smiths Island.

ECHINONEUS CYCLOSTOMUS Leske

Localities.—Smithsonian-Hartford station 4, Bahamas (74, E. 5594). Station 12, Haiti (9, E. 5476). Station 29, St. John (2, E. 5449, E. 5450).

NOTES.—The specimens from station 4 are 3–12 mm in length, mostly very small.

MOIRA ATROPOS (Lamarck)

Locality.—Smithsonian-Hartford station 26, St. Thomas (1, E. 5581).

BRISSOPSIS ATLANTICA Mortensen

Locality.—Smithsonian-Hartford station 4, Bahamas (1, E. 5597).

NOTES.—This specimen is very small, 7.5 mm long by 6.7 mm broad.

HOLOTHUROIDEA

HOLOTHURIA GLABERRIMA Selenka

Localities.—Smithsonian-Hartford station 15, Haiti (2, E. 5566). Station 16, Puerto Rico (2, E. 5568). Station 27, St. John (1, E. 5574). Station 33, St. Croix (3, E. 5567). Station 37, St. Croix (1, E. 5569).

HOLOTHURIA IMPATIENS Forskål

Locality.—Smithsonian-Hartford station 28, St. John (6, E. 5570).

HOLOTHURIA SURINAMENSIS Ludwig

Locality.—Smithsonian-Hartford station 28, St. John (1, E. 5572).

STICHOPUS BADIONOTUS Selenka

Locality.—Smithsonian-Hartford station 28, St. John (1, E. 5573).

THYONE COGNATA (Lampert)

Locality.—Smithsonian-Hartford station 15, Haiti (1, E. 5565).

PENTACTA PYGMAEUS Théel

Locality.—Smithsonian-Hartford station 19, Puerto Rico (9, E. 5571).

LOCALITIES GIVEN IN THE PRECEDING LIST

STATIONS OF THE SMITHSONIAN-HARTFORD EXPEDITION, 1937

Station 3. Bahamas. Nassau Harbor, west end of Atholl Island; March 15.

Station 4. Bahamas. Nassau Harbor, off the south side of Hog Island, halfway between east end and anchorage; bottom coral sand with *Centrechinus;* March 16.

Station 9. Bahamas. San Salvador (Watling Island), rocky point about 2 miles south of Cockburn Town; March 19.

Station 10. Bahamas. San Salvador (Watling Island), vicinity of anchorage, Cockburn Town, 4½–10 fathoms; white-sand bottom; March 19.

Station 12. Haiti. Tortuga Island, reef to east side of Tierra Baja road; 8 feet; scattered coral heads with turtle grass and *Centrechinus*; March 21.

Station 15. Haiti. Cape Haitien, near Dames Point; March 22.

Station 16. Puerto Rico. West end of San Juan Island, in the vicinity of Fort San Geronimo; March 27.

Station 17. Puerto Rico. West end of San Juan Island, in the vicinity of Fort San Geronimo; March 28.

Station 19. Puerto Rico. Off Puntilla Point, parallel to Tablazo Shoal; 3.5 fathoms; bottom broken shell, broken coral, and mud; March 29.

Station 20. Puerto Rico. Off west shore of San Juan harbor, in line with and west of preceding markers (station 19); bottom hard sandy mud, worm tubes, and coral rocks; March 29.

Station 21. Puerto Rico. Mangrove swamp and along peaty shore halfway between airport landing and bridge crossing the lower end of San Juan harbor; March 29.

Station 23. St. Thomas, Virgin Islands. Charlotte Amalia, east shore of harbor, seaward side of coal dock; April 4.

Station 26. St. Thomas, Virgin Islands. Charlotte Amalia, between ships' anchorage and revenue cutter dock; 8–20 feet; sandy bottom; April 5.

Station 27. St. John, Virgin Islands. Coral Harbor, east shore, Hurricane Hole; shingle beach and weed-grown rocks; April 6.

Station 28. St. John, Virgin Islands. West side of Coral Bay, coral reef off Lagoon Point; April 6.

Station 29. St. John, Virgin Islands. Little Cruz Bay, anchorage; 4 fathoms; April 6.

Station 33. St. Croix, Virgin Islands. Judith Fancy Bay; April 9.

Station 37. St. Croix, Virgin Islands. Mangrove Island, Salt River lagoon; April 10.

Station 38. St. Croix, Virgin Islands. North side of Buck Island; April 10.

Station 50. Martinique. Fort-de-France, shore north of fort and east of anchorage; April 15.

Station 55. Martinique. Fort-de-France, about 1 to 2,000 yards off the south shore of the harbor; 8–10 fathoms; almost wholly sponge bottom; April 17.

Station 56. Barbados. Carlisle Bay, north and northeast end of Pelican Island; under rocks and cracked from old coral; April 19.

Station 66. St. Thomas, Virgin Islands. Banana Bay, Water Island; April 24.

Station 68. St. Thomas, Virgin Islands. Smith Bay, reef and beach; April 25.

"ALBATROSS" STATIONS

Station 2016. Off the Eastern Shore of Virginia (lat. 37°31'00" N., long. 74°52'36" W.); 19 fathoms; fine sand and shells; May 5, 1883.

Station 2017. Off the Eastern Shore of Virginia (lat. 37°30'48" N., long. 74°51'24" W.); 18 fathoms; fine sand and shells; May 5, 1883.

Station 2379. Gulf of Mexico, south of Mobile, Ala. (lat. 28°00'15" N., long. 87°42'00" W.); 1,467 fathoms; yellow ooze; March 2, 1885.

Station 2420. Off the mouth of Chesapeake Bay (lat. 37°03'20" N., long. 74°31'40" W.); 104 fathoms; black sand, mud, and gravel; April 5, 1885.

"FISH HAWK" STATION

Station 8369. Mouth of Chesapeake Bay (lat. 36°59'55" N., long. 76°00'42" W.); 7.5 fathoms; hard fine gray sand; October 3, 1915.

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A NEW CAVE ISOPOD FROM FLORIDA

By JAMES O. MALONEY

FROM Horton H. Hobbs, of the University of Florida, the United States National Museum has received a large number of blind isopods from two localities: About 100 specimens from Dudley Cave, Gainesville, Alachua County. Fla., and 4 very small specimens from crayfish burrows at Blountstown, Calhoun County, Fla. They are all representatives of an undescribed species, which I take pleasure in naming for the collector.

Family ASELLIDAE

Genus ASELLUS Geoffroy Saint-Hilaire, 1764

As here considered, *Asellus* includes *Caecidotea* Packard, 1871. This is in accord with the consensus of opinion among most students of the fresh-water Isopoda.

ASELLUS HOBBSI, new species

FIGURE 52

Holotype.—A male specimen from Dudley Cave, Gainesville, Alachua County, Fla., measuring 9½ mm in length and 1¾ mm in width, has been selected as the holotype, U.S.N.M. no. 76434.

Description of holotype.—The body without antennae and uropods measures 9½ mm in length, 1¾ mm in width. Head deeply excavate, a little narrower than first thoracic segment, 1 mm long by 1½ mm wide. The thoracic segments are almost parallel; the first,

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sixth, and seventh segments are about equal in length and are a little longer than the second, third, fourth, and fifth segments, which are also about equal. Telson 2½ mm long by 2 mm wide. The uropods are as long as telson; peduncle is about 1½ times as long as inner joint, outer joint one-half as long as inner and narrower.

First pair of antennae has first peduncular joint broader and a little shorter than second, the third joint about one-half as long as second, and a flagellum of 8 articles. Apices of the fifth, sixth, and seventh joints of flagellum have club-shaped setae. The first antennae extend to the end of the fifth peduncular joint of the second antennae.

Second antenna about 7½ mm long: the peduncle 2 mm and the flagellum 5½ mm. There are approximately 69 joints in the flagellum. The first three peduncular segments are about equal in length and together are as long as the fourth segment. The fifth segment is a little longer than the fourth.

Left mandible with two sets of teeth, each series containing 4 teeth; right mandible has only one set, consisting of 4 teeth. The margin below teeth with 12 plumose setae on each of the mandibles.

Outer ramus of first maxilla with 11 teeth, the 5 innermost being serrate. The inner ramus has 5 long plumose setae.

Second maxilla consists of 3 lobes, the inner being triangular, the two outer ones squarish. Outer lobe has 20 long setae; center one 12 setae; and inner one 10 pronged setae, numerous long, slender hairs, and a few short, curved ones.

Inner plate of maxillipeds and second, third, fourth, and fifth articles of palp on inside, thickly fringed with long hairs.

The first pair of legs are subchelate, with a long, slender process and a shorter bifurcate one at distal end of propodus and 2 spines at proximal end. The inferior side of dactylus is furnished with a row of small spines. The carpus has 2 spines and 2 long hairs. The other legs are ambulatory.

Remarks.—Asellus hobbsi is closely related to *A. alabamensis* (Stafford) from which it differs chiefly in the proportions of the articles of the maxillipeds and in the armature of the propodus of the first pair of legs. The last two articles of the maxillipeds in *A. alabamensis* in their relative proportions are half the width of the same articles in *A. hobbsi*.

The propodus of the first pair of legs in *A. alabamensis* is armed with 2 triangular processes and 3 spines placed proximal to the processes. *A. hobbsi* is armed with 2 triangular processes and 2 spines placed proximal to the processes. Moreover, in *A. hobbsi* the distalmost of the two processes is bifurcate, whereas in the published figure of *A. alabamensis* the corresponding process appears simple.

The four small specimens from Blountstown, which were taken in crayfish burrows, are young of *A. hobbsi.* Any apparent differences between these specimens and the adults are of no greater magnitude than those ordinarily found between young and adults of related species.

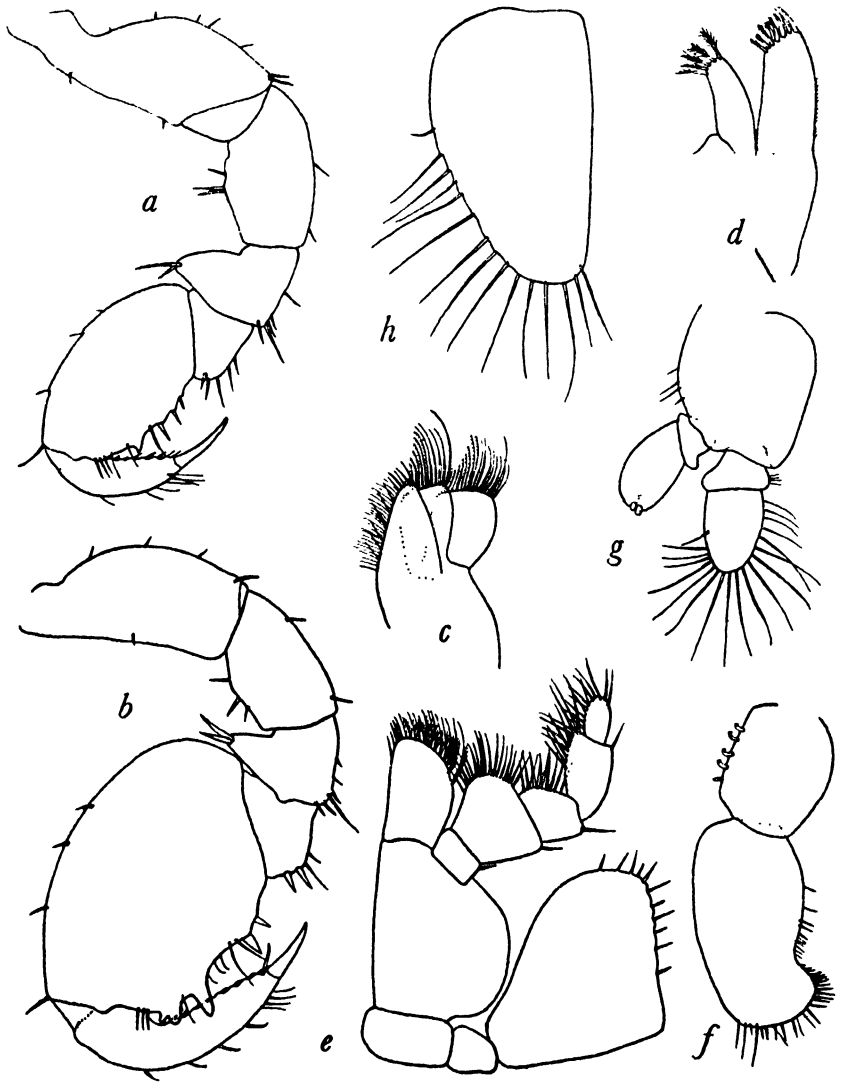


FIGURE 52.—*Asellus hobbsi,* new species: *a,* First leg of female; *b,* first leg of male; *c,* second maxilla; *d,* first maxilla; *e,* maxilliped; *f,* first pleopod of male; *g,* second pleopod of male; *h,* first pleopod of female.

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TWO NEW ATLANTIC SPECIES OF DOG SHARKS, WITH A KEY TO THE SPECIES OF MUSTELUS

By STEWART SPRINGER

DURING the winter months of 1935 to 1938, more than 50 specimens of dog sharks were taken off Englewood on the west coast of Florida and brought in to the Bass Biological Laboratory. All were mature males and were taken in relatively shallow water with gill nets and trammel nets. No substantiated records were found of dog sharks in Gulf waters north of Key West, Fla. These specimens with one other, fortunately an adult female with embryos, in the collection of the United States National Museum, represent a species here described as new and named for Prof. H. W. Norris, of Grinnell College.

In examining the collection of dog sharks in the National Museum, I studied and compared a series of specimens from the east coast of South America with a large series of *Mustelus canis* from the east coast of North America. Constant differences were noted, sufficient to warrant the separation of the South American form as a new species, which is named for Dr. Waldo L. Schmitt, curator of the division of marine invertebrates at the National Museum, collector of the type.

In gathering material for the preparation of these descriptions, I examined the types of *Mustelus lunulatus* Jordan and Gilbert, *M. fasciatus* (Garman), *M. abbotti* Evermann and Radcliffe, and *M. nigromaculatus* Evermann and Radcliffe and studied good series of the species from North America and Japan and representative series of most other species. No specimens were seen certainly referable to *Mustelus punctulatus* Risso, *M. osborni* Fowler, or *M. mento* Cope, and the European and Australian specimens available for study were few.

I am indebted to the authorities of the United States National Museum, the Museum of Zoology of the University of Michigan, the Field Museum of Natural History, and the Stanford University Museum for loans of material and to the Museum of Comparative Zoology at Harvard University for permission to examine specimens in its collections, as well as to Bass Biological Laboratory, for facilities for carrying out the present study. I am very grateful to Earl D. Reid, A. C. Weed, Prof. G. S. Myers, Dr. A. W. Herre, Frank Firth, and Prof. H. B. Bigelow for assistance in making material available for examination, and especially I wish to thank Drs. Leonard P. Schultz and Carl L. Hubbs for their generous help, without which I would have been unable to prepare this paper.

Genus MUSTELUS Linck

MUSTELUS NORRISI, new species

Holotype.—An adult male, 723 mm in total length, U.S.N.M. no. 106639, collected off Englewood, Fla., in about 3 fathoms, March 5, 1938, by Stewart Springer.

Allotype.—An adult female, 825 mm in total length, U.S.N.M. no. 57369, collected in Sawyers Key Channel, a few miles northwest of Key West, Fla., December 14, 1906, by the *Orion*. Six embryos, ranging in size from 182 to 194 mm, were taken from the uterus of one side, and approximately the same number were present in the other side. While the embryos did not have a clearly defined pseudoplacenta, they appeared to be nearly ready for birth, and these organs may have been partly absorbed by the embryos. There were no indications of partitions separating the embryos in the uterus.

Paratypes.—U.S.N.M. no. 104333; Univ. Mich. Mus. Zool. no. 117094 (2 specimens); Bass Biol. Lab. nos. 317, 318, 320, and 321.

Description.—A small species (males mature at 600 mm or less in contrast to those of *M. canis*, which become mature at 750 mm or more). Form slender, tail long, back little elevated. Head relatively narrow, flattened above; snout rounded, of moderate length. A middorsal ridge in the skin extending from before the first dorsal between the fins to the caudal. Fins relatively small; pectorals narrow; lower lobe of the caudal well developed and acute in full-grown specimens; origin of the first dorsal behind the inner angle of the pectoral. Eyes large, with diamond-shaped pupils; distance between nostrils less than horizontal diameter of the orbit. Mouth small, greatly arched, not broadly rounded anteriorly, the lines of occlusion of the jaws forming an angle of 90° or less at the apex; outer labial fold either longer or shorter than the inner, of variable length. Teeth paved but with elevated blunt crowns, higher than in most species of *Mustelus;* with several series in function, teeth of upper and lower

jaws similar, vestigial accessory cusps present on occasional teeth but most of these single; a few teeth, tricuspid in outline, in most specimens examined. Dermal denticles of adults similar in structure over the flat surfaces of the skin of the body, typical denticles regular in outline, 4-ridged, with the two central ridges reaching or nearly reaching the posterior apex, denticles usually longer than broad (one of average size, 0.21 by 0.35 mm), 6-ridged denticles rare even along the

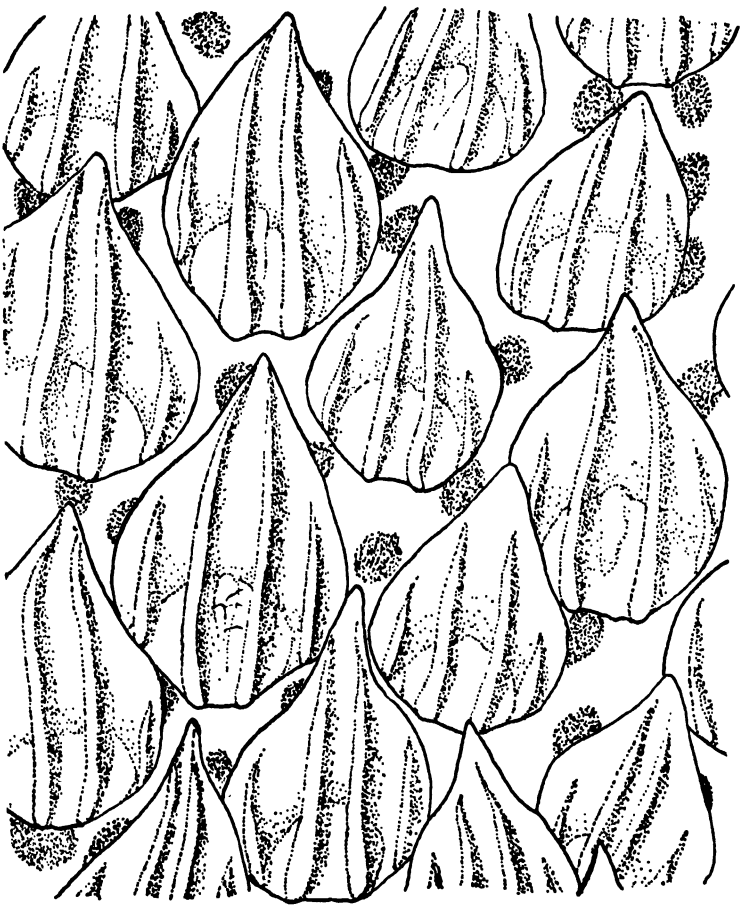


FIGURE 53.—Typical dermal denticles from the lateral surface of *Mustelus norrisi*, new species, showing long ridges, reaching or nearly reaching the apex.

middorsal line. Color uniform, without lighter or darker spots; light gray. Measurements of the types are given in table 1.

Comparisons with other species.—Because of differential growth, especially pronounced in this family as soon as maturity is reached, measurements expressed as a percentage of the total length have little value for taxonomic purposes unless several factors are taken into

consideration. Much more material than I have examined would be required to determine the extent of variation in form within species of dog sharks, but the specimens seen do not demonstrate great variation in form when individuals of the same length and sex are compared.

Mustelus norrisi is most closely allied to *M. lunulatus* Jordan and Gilbert but may be distinguished from it by the more posterior position of the first dorsal. The specimens of *M. lunulatus* seen by me have the inner or lower labial fold definitely longer than the outer, while the specimens of *M. norrisi* usually have the outer labial fold the longer. The well-developed, sharply pointed, lower caudal lobe in adults of both *M. norrisi* and *M. lunulatus* (see fig. 55) distinguishes

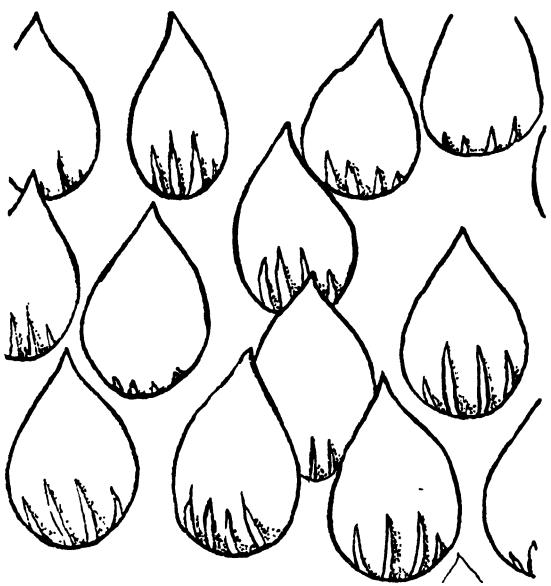


FIGURE 54.—Typical dermal denticles from the lateral surface of *Mustelus mustelus* (Linnaeus), showing short ridges

them from all other species of the genus. *M. norrisi* is much more elongate and slender in form than *M. canis*, has teeth with higher crowns, a more strongly arched jaw, and narrower fins. It may be easily distinguished from *Mustelus mustelus* (Linnaeus) by comparisons of the dermal denticles, which, in that species, are not similar in structure on the flat surfaces of the body.

Mustelus mustelus probably is not normally, if ever, present in American waters but is most closely allied to *M. californicus* Gill. In these two species, specimens of all ages have strongly ridged denticles along the middorsal line, some of which have six instead of the four ridges characteristic of the genus as a whole. Away from the middorsal line, the ridges of the denticles become weak and do not reach more than half the distance to the posterior apex (see fig. 54), the

ridges becoming obscure and even absent on the belly. *M. mustelus* and *M. californicus* are not similar with respect to tooth form, but tooth form is an unstable character in the genus. In all the species that I have been able to examine in large series, some individuals, especially young ones, have been found with abnormal teeth of a more definitely tricuspid outline than would be usual to the species. Young specimens of *M. canis* frequently resemble young specimens of *M. mustelus* in this respect, but on the basis of the denticle characters they are easily separable.

MUSTELUS SCHMITTI, new species

Holotype.—An adult male, 742 mm in total length, U.S.N.M. no. 106640, collected on the coast of Uruguay by Dr. W. L. Schmitt in 1925.

Paratypes.—Two adult males, each 600 mm in total length, U.S.N.M. no. 87680, collected on the coast of Uruguay by Dr. W. L. Schmitt; an immature male, 450 mm in total length, U.S.N.M. no. 55582, collected by J. W. Titcomb, at Buenos Aires, Argentina; a young male, 260 mm in total length, U.S.N.M. no. 87782, taken on the coast of Brazil by Dr. W. L. Schmitt.

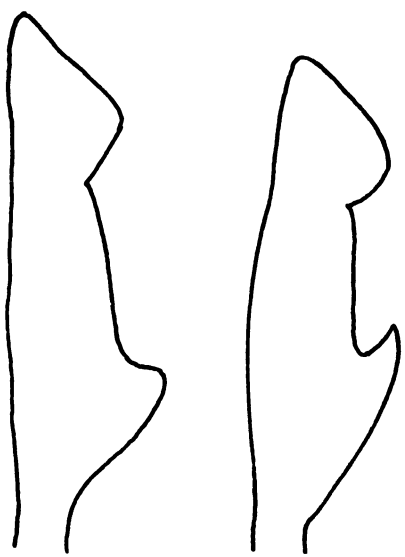


FIGURE 55.—Upper: Outline of the tail of an adult male *Mustelus griseus* Pietschmann, showing rounded lower caudal lobe. Lower: Outline of the tail of an adult male *Mustelus norrisi*, new species, showing pointed lower caudal lobe.

Description.—Similar in form to *Mustelus canis* but males reaching maturity at a small size (600 mm or less). Snout narrower. Fins broad; lower lobe of caudal not strongly developed, not acute; origin of the first dorsal in advance of the inner angle of the pectoral. Eyes smaller than in *M. canis* (horizontal diameter of orbit 2.5 percent of total length in average of five specimens as compared with 3.1 percent average for *M. canis* of comparable size); horizontal diameter of orbit greater than distance between the nostrils. Mouth broadly arched and rounded anteriorly in the adults; outer labial fold longer. Teeth paved, crowns not elevated in adults; accessory cusps present on the teeth of the young specimen, not on the adults examined. Dermal denticles similar in structure on the flat surfaces of the body, typical 4-ridged, with ridges reaching about two-thirds of the distance

to the posterior apex. Color uniform gray, without light or dark spots or bands.

Comparisons with other species.—Mustelus schmitti is most closely allied to *M. canis*. The most striking difference is in the smaller size of the eye, but this character is less reliable in old specimens in which the proportionate size of the head is reduced. The distance between the nostrils is less than the horizontal diameter of the orbit in all the specimens of *M. schmitti* examined, whereas in the large series of *M. canis* examined the internasal distance was always as great as and usually greater than the horizontal diameter of the orbit. The dermal denticles are less uniform in structure than in *M. canis*, the ridges of the denticles of the lateral surfaces extend only about two-thirds the distance to the posterior apex. A few denticles with five

TABLE 1.—*Measurements (in millimeters) of the types of* Mustelus

Measurement	*M. schmitti*	*M. norrisi*	
	U.S.N.M. no. 106640	U.S.N.M. no. 106639	U.S.N.M. no. 57369
Total length	742	723	825
Tip of snout to—			
anterior margin of the orbit	55	51	57
front of mouth (length snout)	45	42	44
outer angle of nostril	37	32	33
first gill opening	123	111	125
last gill opening	156	140	149
base of pectoral	152	134	136
anus	332	317	345
Horizontal diameter of orbit	17	20	23
Vertical diameter of orbit	8	10	9
Mouth, angle to angle (width mouth)	36	35	40
Internasal	16	19	20
Length mouth	24	24	27
Length, outer labial fold	16	8	10
Length, inner labial fold	9	7	9
Outer margin clasper	60	55	----
Inner margin clasper	104	81	----
Snout to origin first dorsal	225	215	262
Anterior margin first dorsal	88	87	105
Posterior margin first dorsal	29	23	24
Distal margin first dorsal	83	70	----
Base first dorsal	88	71	90
Interdorsal	161	190	175
Anterior margin second dorsal	78	63	85
Posterior margin second dorsal	24	23	17
Distal margin second dorsal	60	55	----
Base second dorsal	66	55	70
Second dorsal to beginning of caudal	80	80	90
Length upper caudal lobe	141	133	150
Length lower caudal lobe	59	58	72
Tip caudal to notch	64	45	55
Outer margin pectoral	102	101	125
Inner margin pectoral	60	45	55
Distal margin pectoral	86	80	----
Base pectoral	36	27	30
Anterior margin anal	40	46	51
Posterior margin anal	20	14	16
Base anal	40	41	45

or six ridges are present along the middorsal line. In this respect the denticle structure in *M. schmitti* is intermediate between that of *M. canis* and that of *M. mustelus* but closer to that of *M. canis*.

ARTIFICIAL KEY TO THE SPECIES OF MUSTELUS

The key given below will serve only to indicate some of the characters that may be used to separate the species described here from others of the genus. Many of these characters are of doubtful value and must remain so until large series can be studied. The nomenclature of the genus and the North Atlantic species follows the recent contributions by Dr. Carl L. Hubbs.[1] No attempt has been made to distinguish between the white-spotted species in the key, and *Mustelus mento* Cope and *Mustelus nigromaculatus* Evermann and Radcliffe are excluded from consideration here, as probably they are not referable to the genus.

1. Species with white spots of variable size and intensity, persistent along the sides where they tend to form an irregular line, and usually generally distributed over dorsal surfaces 13
 Species not white spotted; uniform in color or banded or spotted with darker 2
2 (1). Eye small, horizontal diameter of orbit 3 times or more in length of snout measured from front of mouth 3
 Eye larger, horizontal diameter of orbit less than 3 times in length of snout 5
3 (2). Color uniform, without transverse dark bars 4
 Color not uniform, dorsal surface with transverse dark bars **fasciatus** (Garman)
4 (3). Origin of first dorsal in advance of inner angle of pectorals **dorsalis** Gill
 Origin of first dorsal behind inner angle of pectorals **osborni** Fowler
5 (2). Denticles of sides of body (typical denticles from a point about equal to horizontal diameter of orbit below origin of first dorsal) with short ridges not reaching more than one-third the distance toward posterior apex, denticles dissimilar in structure on flat surfaces of body, with ridges very strong near middorsal line and weak or absent on belly 12
 Denticles of sides of body with longer ridges (see fig. 53), the central two at least reaching two-thirds or more of the distance toward posterior apex, denticles nearly uniform in structure on flat surfaces of body 6
6 (5). Lower caudal lobe of adults not strongly developed, tip rounded 8
 Lower caudal lobe of adults strongly developed, tip acute 7
7 (6). Origin of first dorsal in advance of inner angle of pectoral **lunulatus** Jordan and Gilbert
 Origin of first dorsal behind inner angle of pectoral **norrisi**, new species

[1] Hubbs, C. L., Scientific names of the American "smooth dogfish," *Mustelus canis* (Mitchill), and of related European species. Occ. Pap. Mus. Zool. Univ. Michigan, no. 374, 19 pp., 1938.

8 (6). Species not spotted with black, color uniform 9
Black spots present on dorsal surface **punctulatus** Risso

9 (8). Profile of functional surface of typical teeth of upper jaw of adults a regular curve, teeth without a projecting blunt crown or cusp 10
Profile of functional surface of typical teeth of upper jaw of adults an irregular curve, teeth with a projecting blunt crown or cusp 11

10 (9). Distance between nostrils usually greater than horizontal diameter of orbit; eyes of embryos at time of birth large (horizontal diameter of orbit less than 2 times in length of snout) **canis** (Mitchill)
Distance between nostrils usually less than horizontal diameter of orbit; eyes of embryos at time of birth not proportionately large (horizontal diameter of the orbit more than 2 times in length of snout) **schmitti**, new species

11 (10). Origin of first dorsal behind inner angle of pectoral; inner labial fold reaching farther forward than outer **griseus** Pietschmann
Origin of first dorsal over or in advance of inner angle of pectoral; outer labial fold reaching farther forward than inner **antarcticus** Günther

12 (5). Inner labial folds usually reaching farther forward than outer; teeth of adults usually without accessory blunt cusps or crowns **californicus** Gill
Outer labial folds usually reaching farther forward than inner; teeth of adults frequently with accessory cusps on either or both sides of principal crown **mustelus** (Linnaeus)

13 (1). *Mustelus asterias* Cloquet and *Mustelus manazo* Bleeker are white-spotted species. In all the specimens examined these spots have been present although not always distinct in those that have been in preservative for a long period. Pietschmann [3] regards these two species as identical. I have not examined a large enough series of *M. asterias* to form an opinion on this point, but certainly *M. manazo* has a wide range in the Pacific; specimens have been examined from San Diego, Calif., and Wanganui, New Zealand, as well as from the northwest Pacific. The type but not the paratypes of *Mustelus abbotti* Evermann and Radcliffe belongs here.

[3] Zur Unterscheidung der beiden europäischen Mustelus-Arten, Zool. Anz., vol. 33, p. 159-164, 1908.

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A NEW SEA STAR OF THE GENUS PORANIOPSIS FROM JAPAN

By WALTER K. FISHER

THE NEW species of *Poraniopsis* (Echinasteridae) described herein was known to me 30 years ago. It was found in a jar containing fishes dredged off Honshu, Japan, by the *Albatross* in 1906. The genus is an isolated one with a rather curious distribution. First, there is the present Japanese species, the extent of whose range is unknown. *P. inflata* (Fisher) has been dredged from off Oregon to San Diego, Calif., in 26 to 159 fathoms. *P. inflata flexilis* Fisher is a deeper-water race (344 to 600 fathoms) from California, and probably extends to the Gulf of Panama, 458 fathoms. The latter record is based on *Alexandraster mirus* Ludwig, 1905, which is doubtfully distinct. *Poraniopsis mira* (Ludwig) is untenable on account of *Poraniopsis mira* (de Loriol) described a year prior as *Lahillea mira*. In the Magellanic region is found *P. echinaster* Perrier, type of the genus, its range extending to Gough Island south of Tristan da Cunha, 50 to 70 fathoms. I have examined a specimen from this locality and it is *P. echinaster* rather than *P. capensis* H. L. Clark, from Cape Colony, 160 to 230 fathoms. Finally, there is *P. mira* (de Loriol) from the Gulf of San Mathias, Argentina, very distinct from *P. echinaster*.

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Genus PORANIOPSIS Perrier

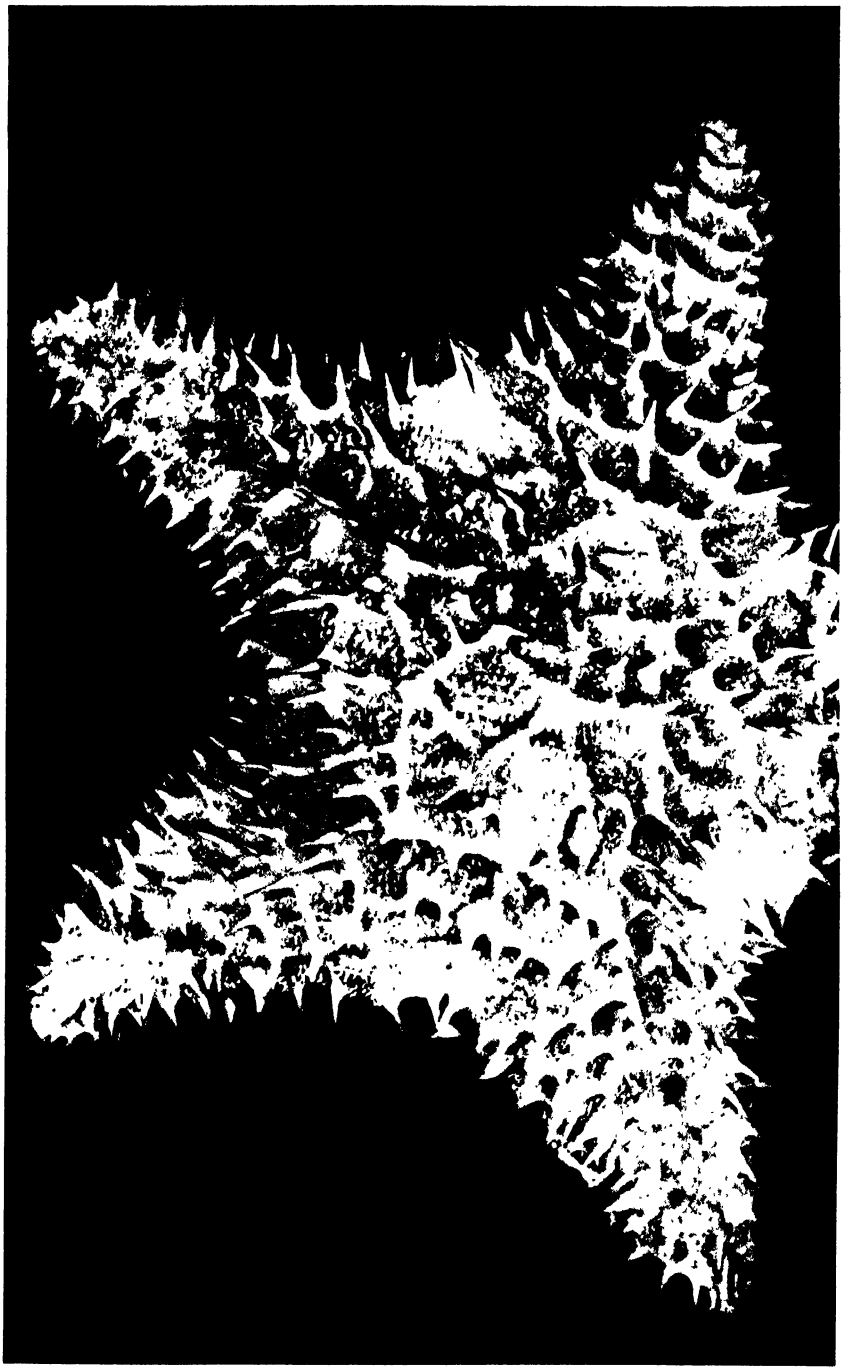
PORANIOPSIS JAPONICA new species

FIGURE 56; PLATES 55, 56

Poraniopsis sp. FISHER, U. S. Nat. Mus. Bull. 76, pt. 1, p. 264, 1911 (off Honshu, Japan, 182 fathoms).

Diagnosis.—Differing from *P. inflata* (Fisher) in having a larger disk, rays broader at base, a decidedly broader abactinal area with more numerous abactinal spines, numerous delicate thorny spinelets immersed in the thick membrane of papular areas, more widely spaced inferomarginal spines, adambulacral spines without well-marked groove. R=77 mm, r=38 mm, R=2r, br=40 mm.

Description.—When the animal is viewed directly from above the superomarginal series of spines curves downward on the sides of ray and marks the border of the actinal area. In *inflata* it is higher on side of ray and fairly straight. As a result the abactinal area is broader in *japonica.* Including the first superomarginal spine of each side, one can count 10 to 12 spines across base of ray, whereas in *inflata* the number is 5 to 8. This means that the dorsolateral spines are more numerous in *japonica;* and as the photograph shows, neither they nor the median radial spines form regular longiseries. These spines are about as long as in *inflata* of comparable size, that is, from 3 to 6 mm, the apparent height being somewhat enhanced by the central convexity of the lobed plate upon which they stand. The skeleton forms well-marked rounded ridges connecting the spines and outlining the large papular areas with their papulae. The skin is rather thicker than in *inflata* and is traversed by numerous anastomosing channels. On the papular areas are low dermal papillae smaller than the papulae, in which are delicate, slender spinelets with thorny sharp projections all along the sides. These spinelets are 0.4 to 0.55 mm long and 0.15 mm thick including thorns, which are 0.027 mm long. These are in the outer layer of the integument. Usually independent of the dermal spinelets, in a lower layer of the integument, are more numerous small plates, 0.12 to 0.6 mm in diameter. The smallest are scarcely more than 3 tiers of very open irregular meshwork, but the largest are thick and opaque under high power. It may be that the thorny spinelets were originally connected each with a platelet and became dissociated by a swelling of the dermis in alcohol, but there are more platelets than spinelets. The latter resemble the dermal spinelets of *Porania glabra* Sladen and may prove to be as variable in number as in that species. They have not been detected in *inflata* and *echinaster* but immediately suggest the thorny dermal spinelets of *Poraniopsis mira* (de Loriol).



PORANIOPSIS JAPONICA, NEW SPECIES.
Abactinal surface of type. Slightly larger than natural size.



PORANIOPSIS JAPONICA, NEW SPECIES.
Actinal surface of type. Slightiy larger than natural size.

In this species, from Argentina, the spinelets are larger and thicker, the length being 2.5 times the thickness, while the thorns are relatively smaller (de Loriol, 1904, pl. 3, fig. 1*h*).

The convex madreporite is 4.5 mm on the interradial (longer) diameter, is guarded by 4 spines, and its inner border is at the middle of r.

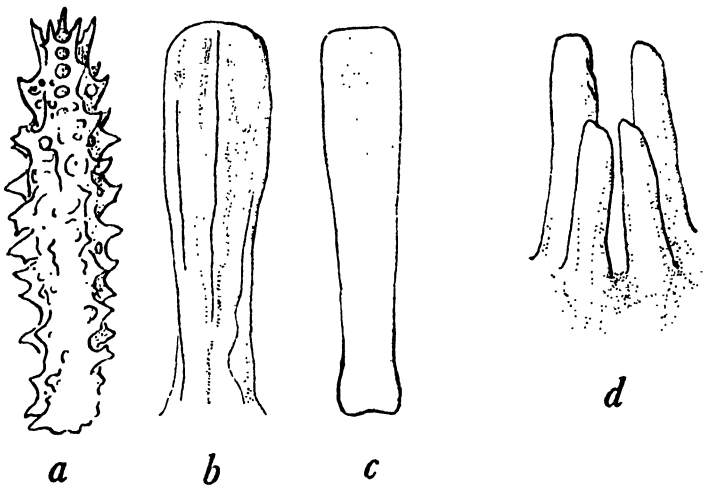


FIGURE 56.—*Poraniopsis japonica*, new species: *a*, Dermal spinelet from abactinal papular area, × 100; *b*, outer of the two adambulacral spines, with its sheath, or sacculus, showing the outer face or that away from the ambulacral furrow, × 10; *c*, same spine as *b*, with sheath removed, × 10; *d*, fifth and sixth adambulacral plates and spines viewed from furrow and showing the sides opposite to *b*, × 5.

The broad intermarginal papular areas, 12 to a side, are actinal in position, becoming lateral sometimes at end of ray. The proximal areas contain the dermal spinelets. Interradially, the distance between the first superomarginal and corresponding inferomarginal spines is one-third r. Superomarginal spines 13, spaced about their own length. The proximal 1 to 5 inferomarginal plates carry a single spine, the others 2 spines except for 1 or 2 triplacanthed plates at midray and a sporadic monacanthed plate near the end; 15 plates in all. The superomarginal spines taper from a broad base to a rather slender blunt point. The inferomarginals are similar, although the tip is sometimes compressed, rounded or incipiently bifid but not markedly channeled. Intermarginal spines at base of ray for the 10 areas are: 1, 1, 0, 1, 0, 2, 0, 1, 1, 2.

Actinal interradial areas with 20 to 23 prominent spines, there being a well-defined arcuate series similar and parallel to the inferomarginals, the outermost spinelet at about middle of ray measured on side. Inside of this an incomplete second series is indicated, which in number and arrangement is not materially different from

that of *inflata* except that the spines are not grooved and have a somewhat heavier sheath.

The adambulacral spines are narrowly spatulate, with subparallel sides, rounded tip, and sometimes a slight concavity of the terminal part but not a marked groove. The rather thick sheath, however, has a well-marked groove for the whole length of the outer side, but the spine itself is not gouge-shaped as in *inflata*. The furrow spine is set on the furrow face of plate at a slightly lower level than the subambulacral, and on proximal plates measures 4.5 mm while the slightly more robust subambulacral is 5 to 5.5 mm.

The mouth plates have 4 (or 3) marginal and 1 suboral spine; the inner marginal is truncate, shallowly grooved, and 5 mm long; the next 3 are successively shorter, the outermost being 2.5 mm. All have rather heavy sheaths.

Type.—U. S. N. M. no. E. 5603.

Type locality.—*Albatross* station 5049, off Honshu, Japan, latitude 38°12′ N., longitude 142°02′ E.; 182 fathoms; dark gray sand, broken shells, Foraminifera; bottom temperature 37.8° F.; one specimen.

Remarks.—This specimen was mentioned by me (1911, p. 264) in connection with an account of *P. inflata*. I have recently studied a specimen of *P. echinaster* Perrier from Gough Island. This specimen lacks any trace of dermal spinelets. It has numerous perforated embryonic plates much smaller and simpler than those of *inflata* and comparable to the first stages of the platelets of *japonica*. *P. echinaster* has 2 inferomarginal spines over part of the ray, very few actinal spines, while the adambulacral spines (occasionally 3) are flattened, spatulate, and not grooved. *P. capensis* H. L. Clark is probably only a race of *echinaster*. *P. mira* (de Loriol),[1] from Gulf of San Mathias, Argentina, differs in having shorter tubercular abactinal spines often with a capitate tip, and, in addition to the spines, the surface of body is covered by a multitude of almost microscopic thorny spinelets, larger and much more numerous than those in *japonica*.

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[1] *Lahillea mira* de Loriol, 1904, p. 32, pl. 3, figs. 1–1g.

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A REVISION OF THE TOADFISHES REFERRED TO PORICHTHYS AND RELATED GENERA

By Carl L. Hubbs and Leonard P. Schultz

In identifying a second species of *Porichthys* occurring along the coasts of southern California and Lower California, we found that the species referred to this American genus stand in need of revision. We have therefore studied all the material of these species in the United States National Museum, in the Museum of Zoology of the University of Michigan, and in the museum of Stanford University and have examined the pertinent literature, as the basis for the present paper. One new genus and two new species are described:

Aphos (for *Batrachus porosus* Valenciennes).
Porichthys myriaster (southern California and Lower California).
Porichthys analis (Gulf of California).

The toadfishes treated are those members of the family Batrachoididae having the following characters: 2 dorsal spines and 1 strong opercular spine, both solid and without connected poison glands; subopercle small, without spine; some of the teeth caninelike; no scales; *4 lateral lines*. With the exception of the Chilean and Peruvian *porosus*, here made the type of a distinct genus, *Aphos*, all species of this group have rows of many photophores (Greene, 1899) following the course of the multiple lateral lines. The presence of these organs is therefore not consistently associated with the increased number of the lateral lines and does not seem to furnish warrant for the separation of a family Porichthyidae, as proposed by Ribeiro (1915).

We separate another genus from *Porichthys*, recognizing *Nautopaedium* Jordan for *porosissimum*, the single, wide-ranging Atlantic species of the group. Thus *Porichthys*, with 5 or 6 species, is re-

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stricted to the Pacific coast, from southern Alaska to Colombia. Only *Porichthys notatus* occurs north of southern California and only *P. greenei* and *P. margaritatus* in the general vicinity of Panama. In southern California and on the outer coast of Lower California both *P. notatus* and *P. myriaster* occur. The center of abundance for the group seems to be the region of the Gulf of California and Cape San Lucas, where we find the northern *P. notatus*, the Panamic *P. margaritatus*, and apparently 2 or 3 additional forms, one of which is here named *P. analis*.

In distinguishing the species of *Porichthys*, we have found the number of anal rays to be particularly useful. Series of counts of anal rays have therefore been made and presented in table 1.

TABLE 1.—*Anal-ray counts of* Porichthys (*last ray counted as a double ray*)

Species and locality	Number of anal rays											Average
	27	28	29	30	31	32	33	34	35	36	37	
P. myriaster:												
Southern California	----	----	----	----	----	----	2	7	16	9	2	35.06
Lower California	----	----	----	----	----	----	----	----	1	1	1	36.00
P. notatus:												
British Columbia (Strait of Georgia)	----	----	----	1	4	2	----	----	----	----	----	31.14
Puget Sound	----	----	1	5	26	17	1	----	----	----	----	31.24
Central California	----	----	----	----	13	26	16	2	----	----	----	32.12
Southern California	----	----	----	----	4	22	10	----	----	----	----	32.17
Outer coast, Lower California	----	----	----	3	5	4	1	----	----	----	----	31.23
Gulf of California	----	----	----	1	2	----	----	----	----	----	----	30.67
P. species:												
Cape San Lucas, Lower California	1	2	----	----	----	----	----	----	----	----	----	27.67
P. analis	----	----	----	----	----	----	----	----	----	2	----	36.00
P. margaritatus:												
Lower California	----	----	----	----	4	2	----	----	----	----	----	31.33
Panama	----	----	----	7	19	4	----	----	----	----	----	30.90
Colombia	----	----	----	7	18	3	----	----	----	----	----	30.86
Galapagos Islands	----	----	----	----	1	1	----	----	----	----	----	31.50
P. greenei	----	----	1	2	----	----	4	7	2	----	----	32.50

ANALYTICAL KEY TO THE SPECIES OF PORICHTHYS AND RELATED GENERA

1*a*. Dorsal spines 2. Opercle with a single strong spine. Subopercle small, without a spine. Dorsal and opercular spines solid and without connected poison glands. Some of the teeth caninelike. Lateral lines 4. Scaleless.

2*a*. Photophores absent.

3*a*. Teeth of palatine and premaxillary not directed forward; those of palatine rather numerous and not confined to front of bone. *Peru and Chile* Aphos

4*a*. Dorsal and anal fin free from caudal. Pectoral fin pointed medially. Peritoneum white in adult. Lateral line organs, especially of dorsal and anal series, fimbriate Aphos porosus

2*b*. Photophores very numerous, developed in rows generally following the courses of lateral lines.[1]

3*b*. Teeth of palatine and premaxillary directed slightly backward in adults of both sexes; those of palatine numerous and not confined to front of bone. *Southern Alaska to Colombia*_____ Porichthys

4*b*. Dorsal and anal fin free from caudal. Pectoral fin pointed medially. Peritoneum blackish in adults. Lateral line organs, especially of dorsal and anal series, fimbriate. Photophores of minute size developed above and below some of the accessory dorsal lateral line organs.

5*a*. Branchiostegal rows of photophores with a U-shaped forward-directed commissure, not markedly constricted at base. Palatine teeth large, needle-shaped canines.

6*a*. Body with dusky dorsal saddles in young; becoming plain with age. Top of head unmarked. Dorsal fin usually more or less blotched with dusky. Anal fin definitely margined with dusky to blackish (except in young). Pleural row of photophores ending abruptly above end of second third of anal base, behind end of pleural lateral line. Anal rays 33 to 37, usually 34 to 36. Dorsal rays 36 to 38. *Southern California and outer coast of Lower California, close to shore*_____ Porichthys myriaster

5*b*. Branchiostegal rows of photophores united in a broad V, without forward projection. Palatine teeth small, somewhat compressed.

6*b*. Body with weak dorsal saddles in young, usually very weak; becoming plain with age. Top of head unmarked. Dorsal fin plain, or with a dusky edge, as a border or in spots. Anal fin more or less darkened, but usually without dark margin, or with a merely dusky border. Pleural row of photophores ending abruptly above end of second third of anal base behind end of pores and cirri of pleural lateral line. Anal rays 29 to 34, usually 31 to 33. Dorsal rays 33 to 36, usually 35. *Alaska to Cape San Lucas; in rather deep water south of Point Conception.* Porichthys notatus

6*c*. Body with 8 rather strong and persumably persistent, broad, light-brown dorsolateral bars, without light centers; without smaller, alternating spots. Top and sides of head unspotted. Dorsal fin with a row of 7 marginal light-brown blotches (separated by light areas from the body bars). Anal fin whitish, with a dusky brown border. Pleural row of photophores not ending above end of second third of anal base but continued backward (as smaller organs) nearly to end of fin; pleural lateral line (pores and strong cirri) extending to caudal fin. Anal rays 36. Dorsal rays 38 or 39. *Gulf of California*_____ Porichthys analis

6*d*. Body with strong and persistent dorsolateral blotches, often with light centers; with smaller, alternating spots in adult. Top and sides of head (and humeral region) definitely spotted with dark. Dorsal fin with a row of marginal black spots or blotches. Anal fin white or dusky to margin. Pleural row of photophores not

[1] The arrangement of the photophores of *Porichthys* is described and figured in great detail and accuracy by Greene (1899), whose account was abstracted by Jordan and Evermann (1898, pp. 2317–2318) and partly quoted by Jordan (1905, vol. 1, pp. 190–197).

ending above end of second third of anal base but continued backward (as smaller organs) nearly to end of fin; pleural lateral line (pores and weak cirri) extending almost or quite to caudal fin. Anal rays 30 to 32. Dorsal rays 31 to 36. *Pacific coast of Tropical America, from Gulf of California and Cape San Lucas to Colombia*_____ **Porichthys margaritatus**

4*c*. Dorsal and anal fin joined to caudal. Pectoral fin rounded. Peritoneum white in adult (adult very small). Lateral line organs usually simple pores. Photophores absent just above and below accessory dorsal lateral line organs.

5*c*. Branchiostegal rows of photophores uniting in a broad V, from the point of which a short median branch extends forward. Palatine teeth somewhat compressed.

6*e*. Body with 6 large, persistent, solid, blackish saddles; without alternating smaller spots. Top of head crossed by a definite blackish bar. Dorsal and anal fins whitish, unmarked. Pleural row of photophores ending above middle of anal fin, but pores of pleural lateral line continued to caudal. Anal rays 29 to 35. Dorsal rays 32 to 38. *Pacific coast of Panama*___ **Porichthys greenei**

3*c*. Teeth of palatine in the adult of both sexes and the posterior premaxillary teeth in adult male directed forward; those of palatine few (usually 3 to 6) and confined to front of bone. *Atlantic coast from Virginia to Argentina (except West Indies?)*_____ **Nautopaedium**

4*d*. Dorsal and anal fin free from caudal. Pectoral fin pointed medially. Peritoneum white in adult. Lateral line organs fimbriate. Photophores of minute size developed above and below accessory dorsal lateral line organs.

5*d*. Branchiostegal rows of photophores with a U-shaped forward-directed commissure noticeably constricted at base. Palatine teeth very large, needle-shaped canines.

6*f*. Body sometimes plain, but usually with a row of dorsolateral spots and another row along dorsal base (the 2 rows often connected in young). Top of head plain or dark-spotted. Dorsal fin with 3 rows of small spots (spots sometimes fused into streaks, or lacking). Anal fin margined with dark. Pleural row of photophores ending above end of second third of anal base, but pleural lateral line continued to end of anal fin. Anal rays 31 to 35. Dorsal rays 33 to 38_____ **Nautopaedium porosissimum**

Bibliographic references of prime systematic importance are starred in the synonymies and in the bibliography. In the synonymies we attempt to give an analysis of the literature as it relates to the nomenclature, distribution, and general biology of each species treated, but do not refer to bare lists or to copied statements of locality or distribution.

APHOS, new genus

Orthotype.—Batrachus porosus Valenciennes.

In agreement with the very plausible suggestion made by Thompson (1916, p. 468), we erect this new genus for the sole reception of *Porichthys porosus* (Valenciennes), because this species alone among

all those referred to *Porichthys* lacks the complex photophores (Greene, 1899) so characteristic of the group. The photophores in *Aphos* seem to be totally lacking, despite the statement by Evermann and Radcliffe for the type of *Porichthys afuerae* (which we regard as a synonym of *Aphos porosus*) that "the lines of phosphorescent organs are essentially the same as in *P. margaritatus*, but much smaller and less clearly defined, in some places being almost invisible." Presumably these authors were confusing the pores and the photophores, for the type of *afuerae* shows no photophores.

In other respects, so far as apparent, *Aphos* agrees with *Porichthys*, as that genus is here defined, but the one distinction is regarded as fully sufficient for generic separation. We do not, however, agree with Ribeiro (1915) in regarding the characters as of family significance.

The one species of *Aphos* occurs in Peru and Chile, where it is the only representative of the *Porichthys* group.

Aphos, from ἀ, without + φῶς, light.

APHOS POROSUS (Valenciennes)

Batrachus porosus *Valenciennes, *in* Cuvier and Valenciennes, 1837, pp. 506–507, pl. 368 (original description).—Gay, 1848, p. 296 (Valparaiso).

Porichthys porosus *Girard, 1855a, p. 141 (new combination).—*Günther, 1861, p. 177 (description).—*Jordan, 1884b, p. 41 (teeth).—*Meek and Hall, 1885, pp. 55, 56 (diagnosis, synonymy).—Reed, 1897, p. 661 (Valparaiso).—Steindachner, 1898, p. 306 (Iquique, Chile).—Delfin, 1901, pp. 89–90 (synonymy, records).—Fowler, 1916, p. 65 (Valparaiso).—Thompson, 1916, pp. 456, 458 (Tome, Chile). (Type locality: Valparaiso, Chile.)

Batrachus chilensis *Gay, 1848, p. 297 (original description).—Reed, 1897, p. 661. (Type locality indicated only by name of species.)

Porichthys afuerae *Evermann and Radcliffe, 1917, pp. 152–153, pl. 14, fig. 1 (original description). (Type locality: Lobos de Afuera, Peru.)

The examination of new material (table 2) fails to confirm Evermann and Radcliffe's (1917) separation of a larger-headed Peruvian species (*afuerae*) from the typical, Chilean *porosus*. These authors indicated that the length of the head in the types of *afuerae* enters the standard length 3 times and the total length 3.6 or 3.41 times (two statements), whereas in *P. porosus* the head is contained 4.66 times in the total length, according to Günther.

In addition to the fishes listed in table 2, we have examined the following material, all very small specimens collected by Dr. W. L. Schmitt in Peru, during January 1935: U.S.N.M. no. 101722 (18 specimens), Afuera, Lobos Islands, North Bay, 12 fathoms, January 17; nos. 101723 (1 specimen) and 101724 (8 specimens), all from Afuera, Lobos Islands, South Bay, 14 to 16 fathoms, January 17;

no. 101720 (2 specimens), Independencia Bay, clean sand bottom at 3.5 fathoms, January 14; no. 101721 (1 specimen), Callao, January 11. The lack of photophores in these specimens is definitely appreciable.

TABLE 2.[1]—*Measurements of the head in specimens of* Aphos porosus *from Peru and Chile*

Locality	In hundredths of standard length								
	27	28	29	30	31	32	33	34	35
Peru	-----	2	2	2	6	2	1	-----	----
Chile	2	-----	-----	1	-----	-----	-----	1	1
Uncertain locality	-----	-----	3	-----	-----	-----	-----	-----	----

[1] The data in this table were taken from specimens bearing the following U.S.N.M. numbers: 77382, Tome, Chile; 77383, locality ?; 77552 (type of *P. afuerae*), Lobos de Afuera, Peru; 88808, Lota, Chile; 101719, north shore of Middle Chincha Island, Peru; 102048, Independencia Bay, Peru; and 103432, locality ?; and Stanford University no. 22680, Tome, Chile. In addition, 12 specimens from San Juan and Independencia Bays, Peru, collected by the 1938 Hancock Expedition, are recorded through the courtesy of Dr. George S. Myers. The lengths of all specimens range from 19.9 to 222 mm.

Genus PORICHTHYS Girard

Porichthys *GIRARD, 1855a, p. 141 (original description); 1858, p. 134 (description).—*GÜNTHER, 1861, pp. 175–176 (description).—*KNER, 1865, pp. 189–190 (description).—*JORDAN and GILBERT, 1883a, pp. 750–751 (diagnosis, type designation).—*MEEK and HALL, 1885, pp. 52, 55–57 (description, review of species).—*JORDAN and EVERMANN, 1898, pp. 2317–2323 (description, description of lateral line and pore structure quoted from Greene, analysis and description of species).—BEAN and WEED, 1910, pp. 514, 515, 525 (comparison).—RIBEIRO, 1915, p. — (description, type of new family).—MEEK and HILDEBRAND, 1928, pp. 910, 922 (diagnosis, *Nautopaedium* a synonym).

Type.—"*Porichthys notatus* Grd. = *Batrachus porosissimus* C. & V." (designated by Jordan and Gilbert, 1883a, p. 751).

The species of *Porichthys* are compared in the preceding key and in tables 1 and 3.

PORICHTHYS MYRIASTER, new species

FIGURE 57, *b*

Porichthys notatus (misidentifications) YARROW and HENSHAW, 1878, p. 202 (color).—JORDAN and EVERMANN, 1898, pp. 2321–2322 (synonymy, description; in part).—STARKS and MORRIS, 1907, pp. 230–231 (color, range, and habitat; in part).—STARKS and MANN, 1911, p. 16 (bathymetric distribution; in part).—OSBURN and NICHOLS, 1916, p. 177 (records for bays on outer coast of Lower California, identifications presumptive).—HUBBS, 1920, p. 380 (bionomics; in part).—GREENE and GREENE, 1924, pp. 501–506, fig. 1 (San Pedro Harbor record, phosphorescence; good figure).—BARNHART, 1936, pp. 92–93 (diagnosis; in part), fig. 281.

Porichthys porosissimus (misidentifications) JORDAN and GILBERT, 1880, p. 25 (San Diego; in part).—BEAN, 1880, p. 83 (records; in part).—JORDAN and GILBERT, 1881a, p. 454, and 1881b, p. 65 (records; in part); 1883a, pp. 751–752 (description; in part).

Porichthys margaritatus (misidentifications) JORDAN and GILBERT, 1882b, p. 291, and 1883a, p. 958 (in part); JORDAN, 1884b, p. 41 (range and synonymy; in part); 1885b, p. 116 (in part).—MEEK and HAIL, 1885, p. 56 (synonymy; in part).—EIGENMANN, 1892, p. 171 (in part).

As indicated in the key, this heretofore unrecognized species differs from *P. notatus* (and from all other species here retained in *Porichthys*) in the U-shaped forward-directed commissure of the branchiostegal rows of photophores (compare fig. 57, *b* and *c*); in the larger, more needlelike palatine teeth; typically in the more conspicuous dorsal saddles and more blotched dorsal fin (these juvenile traits tend to disappear with age but are more persistent in *myriaster* than in *notatus*); and in the definitely dark-margined anal fin (the young have the fin clear). The distinctness of *myriaster* from *notatus* is proved by the higher number of anal rays, for there is little overlap in the counts (table 1). The corresponding difference in number of dorsal soft rays (table 3) is not quite so sharp.

Porichthys myriaster also shows a habitat distinction from *P. notatus*, although its entire range is overlapped by that of *notatus*. Along the coasts of southern California and Lower California *myriaster* is the characteristic form of the muddy and sandy bays, and along the open shore it tends to live in shallower water than *notatus*. The difference in bathymetric range is partly obscured by the tendency of the young of *notatus* to mingle with *myriaster* in rather shallow water (to 25 fathoms). The only specimen of *myriaster* known from water deeper than 25 fathoms is one adult taken at 69 fathoms.

P. myriaster apparently does not share with *P. notatus* the habit which that form exhibits (in the cooler portion of its range) of migrating into the intertidal zone of the rocky reefs for spawning (Hubbs, 1920). The very few records of *Porichthys* approaching or entering this zone in southern California probably refer to *P. notatus*. *P. myriaster* is apparently more of a bay and less of a reef inhabitant.

The holotype of *Porichthys myriaster* (U.S.N.M. no. 8483) is an adult 306 mm in standard length and 347 mm in total length, collected by Cassidy at San Diego. It is apparently not the specimen (U.S.N.M. no. 694) recorded as *Porichthys notatus* by Girard (1858) as taken by Cassidy at San Diego, for that fish was also found.

Description of holotype.—Dorsal, II–36; anal, 33; pectorals 20–20; pelvics I, 2. Gill rakers on lower part of first arch 17. Palatine teeth caninelike, curved backward, 9 in the single series on each side; vomerine canines 1 or 2 at each outer angle of bone, very strong, curved backward; premaxillary teeth conical, strong, uniserial;

mandibular teeth conical, strong, biserial at front of jaw with the inner row continued backward as canines. Peritoneum blackish. The coloration of head, body, and fins is described in item 6*a* of the key (p. 475).

Measurements in thousandths of the standard length for the holotype and (in parentheses) for 9 paratypes 53 to 304 mm long: Greatest depth, 173 (163–219); distance from tip of snout to origin of soft dorsal, 353 (328–366); to origin of spinous dorsal, 281 (260–300); from tip of chin to anus, 451 (385–430); length of head, 286 (270–310); interorbital width, 88 (68–95); length of orbit, 36 (36–60); of upper jaw, 150 (140–159); of snout, 78 (64–87); distance from tip of lower jaw to anteriormost point of the U-shaped forward extension of the branchiostegal row of photophores, 62 (47–62); between the nearly parallel ventral rows of photophores, 33 (23–33); from anus to anterior extension of ventral row of photophores, 199 (165–195); height of pectoral arch of pleural row of photophores, 38 (23–44); length of this arch, 118 (94–148).

Measurements of 9 paratypes 53 to 304 mm long, stepped into standard length: Greatest depth, 4.8–6.1; length of head, 3.2–3.7. Height of pectoral arch of the pleural row of photophores in length of arch, 2.8–4.2; least distance between ventral rows, 4.9–6.5 in distance from anus to anterior tip of that row; distance from tip of chin to anterior tip of branchiostegal row, 3.6–6.5 in head.

The following paratypes of *Porichthys myriaster* are deposited in the National Museum: U.S.N.M. no. 17046, Santa Barbara, Calif.; nos. 24814, 24863, 24881, 26805, 31349, 34757, 34777, 54738, 54748, 54749, 54757, 54760, 54764, and 62409, all from "San Diego" or San Diego Bay, Calif.; no. 103431, from latitude 32°34′30″ N., longitude 117°18′45″ W.

The following paratypes of *Porichthys myriaster* are deposited in the Museum of Zoology, University of Michigan: No. 63610, Anaheim Bay, Calif.; 64146, off Mira Mar Pier, Calif.; 64148, 34°21′20″ N., 119°31′20″ W.; 64149, 32°36′00″ N., 117°13′15″ W.; 86050 and 105489, Turtle Bay, Lower California; 80829, Magdalena Bay, Lower California; 115795, San Pedro, Calif.; 115820, from 34°17′20″ N., 120°13′00″ W.; 115821, Carpenteria to Rincon, Calif.; 115822, 34°27′30″ N., 120°11′20″ W.; 115823, 34°27′00″ N., 120°03′30″ W.

myriaster, from μῦριάς, myriad + ἀστήρ, star, referring to the multitudinous photophores, which when active shine like stars.

PORICHTHYS NOTATUS Girard

Porichthys notatus *Girard, 1855a, p. 141 (original description); 1855b, p. 151 (records); *1858, pp. 134–136 (description, records); *1859, p. 50, pl. 25 (diagnosis, figure of type).—Suckley, 1860, p. 356 (diagnosis; Fort Stellacoom, Puget Sound).—*Jordan and Starks, 1895, p. 840 (natural history;

distinct from *margaritatus*).—*JORDAN and EVERMANN, 1898, pp. 2321–2322 (synonymy, description; in part).—*GREENE, 1899, pp. 667–696 (photophores, range except Panama).—JORDAN, 1905, vol. 1, pp. 190–197, figs. 146–148 (Greene quoted on photophores); vol. 2, p. 526.—EVERMANN and GOLDSBOROUGH, 1907, pp. 224, 335 (Union Bay, British Columbia, not Alaska).—STARKS and MORRIS, 1907, pp. 230–231 (color of young; Sitka to Gulf of California; in part).—HOLDER and JORDAN, 1909, pp. 315-318 (noise, etc.).—EVERMANN and LATIMER, 1910, p. 139 (records).—STARKS and MANN, 1911, p. 16 (bathymetric distribution; in part).—(?) METZ, 1912, p. 41 (records, not verified).—HALKETT, 1913, p. 109 (range, including British Columbia).—KINCAID, 1919, p. 40 (natural history; Puget Sound).—BEAN and WEED, 1920, p. 79 (Ucluelet, Vancouver Island).—*HUBBS, 1920, p. 380 (bionomics; in part, but nearly all observations based on *notatus*).—GREENE and GREENE, 1924, pp. 500–506 (Monterey Bay; phosphorescence).—SCHULTZ, 1936, p. 197 (range).—SCHULTZ and DELACY, 1936, p. 142 (record; Puget Sound).—BARNHART, 1936, pp. 92–93 (diagnosis; in part). (Type locality: ["South Fork" of] San Francisco [Bay], California.)

Porichthys porosissimus (misidentifications) GÜNTHER, 1861, p. 176 (records for Vancouver Island only).—BEAN, 1880, p. 83 (records; in part).—JORDAN and GILBERT, 1880, p. 25 (San Diego; in part); 1881a, p. 454 (records; in part); 1881b, p. 65 (habitat; in part).—JORDAN and JOUY, 1881, p. 5 (records).—JORDAN and GILBERT, 1883a, pp. 751–752 (description; in part).—KERMODE, 1909, p. 89 (British Columbia).—PRINCE, 1910, pp. 1068–1069 (voice, parental care; name misspelled *porissimus*).

Porichthys margaritatus (misidentifications) JORDAN and GILBERT, 1882b, p. 291 (in part); 1883a, p. 958 (in part).—JORDAN, 1884a, p. 291 (Vancouver Island record only); 1884b, p. 41 (range and synonymy; in part); 1885a, p. 388 (in part); 1885b, p. 116 (in part).—*MEEK and HALL, 1885, p. 56 (synonymy; in part).—TEST, 1889, pp. 43–52, pl. 4 (photophores).—EIGENMANN and EIGENMANN, 1889a, pp. 32–34 (photophores); 1889b, p. 131 (eaten by rock cod, Cortez Banks).—EVERMANN and JENKINS, 1891, p. 162 (synonymy; in part; Santa Barbara record).—EIGENMANN, 1892, pp. 126, 131, 171 (synonymy, egg, ecology; in part; Cortez Banks).—BEAN and WEED, 1920, p. 79 (Vancouver Island).

Porichthys FRASER, 1921, p. 48 (intertidal reef, Strait of Georgia).

This species has a wide distribution, both geographically and ecologically. It ranges from Sitka in southern Alaska to the Gulf of California (Starks and Morris, 1907, p. 230) and occurs (as a variant race) almost as far south as Cape San Lucas. Bathymetrically its habitat extends from the intertidal zone to depths as great as 145 fathoms. It has generally been stated that this form lives in deeper water to the southward, but this seems true only in that it largely avoids the bays and shoals in the south. From the vicinity of Point Conception northward it freely migrates (Greene, 1899) into the intertidal zone to spawn but seldom enters this zone south of Point Conception (Hubbs, 1920). It is common in the bays from central California northward, whereas to the southward it is largely if not entirely replaced in the bays by *Porichthys myriaster*. It occurs in deep water in the north as well as in the south.

In view of its wide geographic and bathymetric range, it is not surprising that *Porichthys notatus* exhibits considerable variation. The anal rays (table 1), averaging highest in California, decrease in average number both toward the north and the south. A marked backward extension of the pleural row of photophores was indicated by Greene (1899, p. 676) for Alaskan specimens, but some doubt is attached to the claim (see page 488). The race in the Puget Sound region is unusually heavy-set and dark. Specimens dredged in moderate depths off the outer coast of Lower California and in the Gulf of California differ from typical *notatus* not only in the slightly reduced number of anal rays but also in a slightly greater tendency for the retention into half-grown stages of the 6 or 7 dusky saddles, and in the more frequent and distinct tendency of the anal fin to become margined with dusky; they also average lighter in color. Occasionally one or a very few minute photophores may be discerned behind the normal termination of the pleural row.

The most aberrant individual that we have referred to *P. notatus* was dredged the farthest south, on the outer coast of Lower California not far north of Cape San Lucas. This specimen (U.S.N.M. no. 46675), a large young fish 82 mm in standard length, was dredged by the *Albatross* on May 1, 1888, at station 2830, in 66 fathoms, at latitude 23°33′ N., longitude 110°37′ W. Unlike the two doubtful forms described below, it has 33 anal and 36 soft dorsal rays. It differs distinctly from the types of *P. analis* in having fewer blotches on the back and on the dorsal fin, the margin of the anal fin darker, no cirri on the posterior pores of the pleural lateral line, and the head larger (3.4). The 6 large dark-brown dorsolateral blotches are more conspicuous than in *notatus* but less so than in *margaritatus*. The marginal blotches on the dorsal fin are quite unlike the continuous dark edging of *notatus* but are rather fewer and more elongate than in *analis* or *margaritatus*. The blackish-brown border of the anal fin is stronger than in any other specimen at hand of *notatus*. A few small photophores are present in the pleural row behind the main ones, and pores without developed cirri continue in the pleural row about to the end of the anal base.

In various respects the Lower California races of *P. notatus* show some approach toward *P. myriaster* and toward *P. margaritatus*. No intergradation between *notatus* and *myriaster* is indicated, however, for the distinction in the course of the branchiostegal row of photophores remains trenchant, and the difference in the number of anal rays is accentuated in Lower California (table 1). It is possible that intergradation with *P. margaritatus* will be discovered, since that species and *notatus* seem very closely allied. The interrelation between *margaritatus* and *notatus*, in the approximate region of the

overlap in their distribution, is complicated by the probable existence there of two additional forms of the same general type. These are discussed below as *Porichthys* sp. and *Porichthys analis*, new species.

The following collections of *Porichthys notatus* in the U. S. National Museum have been examined: U.S.N.M. no. 520, San Francisco Bay (type); 521, Presidio, Calif.; 523, Fort Steilacoom, Wash.; 694 and 103435, San Diego, Calif.; 4474, San Francisco, Calif.; 7536, Victoria, British Columbia; 26647, off Point Loma, Calif.; 26889, Santa Barbara, Calif.; 27277, Puget Sound, Wash.; 41878, Cortez Banks, Lower California; 46461, 34°12′30″ N., 120°32′30″ W.; 46462, 34° N., 120°23′ W.; 46476, 32°44′30″ N., 117°23′ W.; 46479, 24°24′30″ N., 111°53′ W.; 46481, 26°14′ N., 113°13′ W.; 46493, 32°34′30″ N., 117°18′45″ W.; 46494, 29°19′00″ N., 112°50′ W.; 46644, 28°07′00″ N., 111°39′45″ W.; 46675, 23°33′ N., 110°37′ W.; 46731, 29°40′ N., 112°57′ W.; 48572, 37°38′00″ N., 123°02′30″ W.; 53817, Bellingham, Wash.; 54500, 34°23′30″ N., 120°19′30″ W.; 54628, 37°06′40″ N., 122°37′30″ W.; 59399, 37°30′00″ N., 123°02′30″ W.; 59400, Comox, British Columbia,; 60582 and 60821, Union Bay, British Columbia; 60583, near Port Townsend, Wash.; 67313, San Pablo Bay, Calif.; 67314, San Francisco Bay, Point San Bruno; 70957, Union Bay, Bayne Sound, British Columbia; 75459, Pacific Grove, Calif.; 75607 and 75608, off Point Pinas Light, Calif.; 75610, off La Jolla, Calif.; 77979, 33°17′00″ N., 118°24′00″ W.; 82155, Ucluelet, British Columbia; 83971, Union Bay, east of Coal Wharf, British Columbia; 101400, Dillon Beach, Calif.; 102286, Santa Barbara or Santa Barbara Islands.

The following collections of *Porichthys notatus* in the Museum of Zoology, University of Michigan, have been examined: Nos. 56332 and 63608, from Monterey Bay, Calif.; 61695, between Avila and Pismo, Calif.; 61696, Mussel Point, Pacific Grove, Calif.; 61697, near Piedras Blancas, Calif.; 63601, 63602, 63604, 63607, and 63609, all from San Francisco Bay, Calif.; 63603, near Point Reyes, Calif.; 63605, Elkhorn Slough, Calif.; 63606, off Del Monte, Calif.; 64145, 34°27′30″ N., 120°11′20″ W.; 64147, 34°27′00″ N., 120°03′30″ W.; 64148, 34°21′20″ N., 119°31′20″ W.; 64150 and 64151, off Long Beach, Calif.; 64152, Carpenteria to Rincon, Calif.; 64153, lat. 34°17′20″ N., long. 120°13′00″ W.; 64154, off San Pedro, Calif.; 92602, Drakes Bay, Calif.; 94012–94017, all from Hoods Canal, near Holly, Wash.; 115796, Puget Sound, Everett, Wash.

The following collections of *Porichthys notatus* in the Natural History Museum of Stanford University have been examined: No. 91, 34°18′30″ N., 119°41′ 00″ W.; 5050, 37°06′00″ N., 122°32′00″ W.;

5191, 37°13′50″ N., 122°32′30″ W.; 5192, 37°44′50″ N., 122°43′00″ W.; 5211, 35°40′30″ N., 121°22′40″ W.; 5574, Pacific Grove, Calif.; 10700, San Francisco Market; 21341, San Juan Islands, Wash.; 32242, McNears Point, San Pablo Bay.

PORICHTHYS species

Porichthys margaritatus (presumably a misidentification) JORDAN and GILBERT, 1882c, p. 368 (record of specimens discussed below).

Three young specimens (U.S.N.M. no. 3004), 39.5 to 41.5 mm in standard length, collected by Xantus at Cape San Lucas, seem to represent an undescribed species of *Porichthys*. The anal rays are 27 in one and 28 in two, whereas only one other specimen of the genus examined (an example of *P. notatus*) has as few as 29 anal rays. The dorsal rays are correspondingly decreased (table 3). The specimens though poorly preserved show 6 large dusky dorsolateral blotches. The small photophores in the pleural row behind the main ones are rather numerous, at least on one side of one specimen (some are evident on the opposite side of this individual, and on the other specimens), but the condition of preservation does not permit it to be determined with certainty whether these small organs are as well developed as in *P. margaritatus*. Nor are the lateral line structures to be precisely determined.

TABLE 3.—*Dorsal rays in species of* Porichthys

Species	Number of dorsal rays									
	30	31	32	33	34	35	36	37	38	39
P. myriaster							4	5	7	
P. notatus				1	4	16	5			
P. species	2									
P. analis									1	1
P. margaritatus		1		3	2	3	2			
P. greenei			1	1	1	2	4	3	2	

The V-shaped branchiostegal row of photophores as well as the number of fin rays excludes these specimens from *P. myriaster*. The contrast in radial formula is greatest when these specimens are contrasted with the two types of *P. analis*. They agree rather well with corresponding young of either *notatus* or *margaritatus* and may represent aberrant examples or a subspecies of either form. The agreement is particularly close with the original figure and description of *Batrachus margaritatus* from the Gulf of Fonseca, and they may represent the true *margaritatus* if that form should be distinct from the one (*nautopaedium*) usually assigned the name.

The available specimens of this form are unfit to serve as the basis for the proposal of a new name. The examination of material newly collected about Cape San Lucas should solve its status.

PORICHTHYS ANALIS, new species

Two specimens of *Porichthys* from the Gulf of California present characters that indicate rather conclusively a specific difference from both *notatus* and *margaritatus*. They were dredged by the *Albatross* on March 24, 1889, at station 3017, in 58 fathoms, at latitude 29°54′30″ N., longitude 113°01′00″ W. The holotype, 95.5 mm in standard length and 108 mm over all, is cataloged in the National Museum as no. 46645. The one paratype, measuring 80 and 93.5 mm, is U.S.N.M. no. 106503.

In number of dorsal and anal rays (tables 1 and 3) *P. analis* agrees with *P. myriaster*, but it has the V-shaped branchiostegal row of photophores characteristic of *notatus* and its variants as well as *margaritatus*. When *analis* is compared with *notatus* the increased number of fin rays seems particularly significant in view of the apparent decrease southward (from California) in average number of rays. It differs further from *notatus* in having the pleural row of photophores as in *margaritatus* continued backward (as smaller organs) from the end of second third of anal base nearly to end of fin. Instead of ending before the end of the large organs of the pleural photophores, the pores and cirri of the pleural branch of the lateral line extend to the caudal fin. The pores in this extension of the pleural line are even stronger than in *margaritatus*. Further differences between *analis* and both *notatus* and *margaritatus* lie in the coloration of the body, head, and fins, as specified in items 6*b*, 6*c*, and 6*d* of the key (pp. 475–476).

Dorsal II–38 (II–39)[8]; anal 36 (36); pectorals 19–20 (20–20); pelvics I, 2. Gill rakers on lower part of first arch 16 (16). Palatine teeth caninelike, very slightly curved backward, 7 to 9 in the single series on each side, the anteriormost teeth strongest; vomerine canines 1 or 2 at each outer angle of bone; rather strong, very slightly curved backward; premaxillary teeth conical; mandibular teeth biserial anteriorly, with the inner row continued backward as strong canines. Peritoneum brownish black. The coloration of body, head, and fins is given in the key, under item 6*c* (p. 475).

Measurements in thousandths of the standard length: Greatest depth, 181 (195); distance from tip of snout to origin of soft dorsal, 324 (336); to origin of spinous dorsal, 268 (275); from tip of chin to anus, 372 (388); length of head, 273 (280); interorbital width, 65

[8] Items in parentheses are for the paratype.

(66): length of orbit, 58 (61); of upper jaw, 137 (150); of snout, 63 (73); distance from tip of lower jaw to tip of V of branchiostegal row of photophores, 81 (85); least distance between the nearly parallel ventral rows of photophores, 31 (37); from anus to anterior extension of ventral row of photophores, 156 (160); height of pectoral arch of pleural row of photophores, 42 (42); length of this arch, 88 (92).

It is possible that specimens of this species have been reported under another name. The material recorded from the Gulf of California by Jordan and Gilbert (1882a, p. 274), Evermann and Jenkins (1891, p. 162), and Breder (1936, p. 47) in particular should be reexamined with this idea in mind.

analis, pertaining to the anal (fin), with reference to the increased number of rays.

PORICHTHYS MARGARITATUS (Richardson)

FIGURE 57, *d*

Batrachus margaritatus *RICHARDSON, 1844, pp. 67–69, pl. 38, figs. 2–4 (original description).

Porichthys margaritatus *JORDAN and GILBERT, 1882b, pp. 291–292 (*notatus* a synonym; comparison); 1883a, p. 958 (in part); 1883c, p. 626 (Central America).—JORDAN, 1884a, p. 291 (Panama record; distinct from *porosissimus*); *1884b, p. 41 (range and synonymy; in part); 1885a, p. 388 (Panama); 1885b, p. 116 (in part).—*MEEK and HALL, 1885, pp. 55–57 (synonymy; in part; distinct from *porosissimus*).—EVERMANN and JENKINS, 1891, pp. 127, 162 (synonymy; in part; Guaymas record, not verified).—*JORDAN and STARKS, 1895, p. 840 (*notatus* distinct; *nautopaedium* a synonym).—*JORDAN and EVERMANN, 1898, pp. 2319, 2322–2323 (description, synonymy).—*GILBERT and STARKS, 1904, pp. 184–185 (Panama record).—*MEEK and HILDEBRAND, 1928, pp. 922–924 (synonymy, description).—BREDER, 1936, p. 47 (records, northern part of Gulf of California to Perlas Islands, Panama—perhaps in part based on other species).—KUMADA, HIYAMA, ARITA, TOMITA, and MURAMATSU, 1937, p. 57 (misspelled *margitatus*), pl. 41. (Type locality: Gulf of Fonseca, Pacific coast of Central America.)

Porichthys porosissimus (misidentification) *GÜNTHER, 1861, p. 176 (in part).—(?) JORDAN and GILBERT, 1882a, p. 274 (Gulf of California in 15 fathoms—record not verified); 1883a, pp. 751–752 (description; in part).

Porichthys notatus (presumed misidentification) BOULENGER, 1899, p. 3 (Rio Tuyra, Darien).—GREENE, 1899, p. 668 (Panama).

Porichthys nautopaedium *JORDAN and BOLLMAN, 1890, pp. 171–172, 182 (original description, records).—GREENE, 1899, pp. 668, 678 (photophores; name misspelled *nautopedium*). (Type locality: Pacific Ocean off coast of Colombia at *Albatross* station 2802, lat. 8°38′ N., long. 78°31′30″ W., in 16 fathoms.)

Some doubt is attached to the use of the name *margaritatus* for the species more recently named *nautopaedium*. The original description

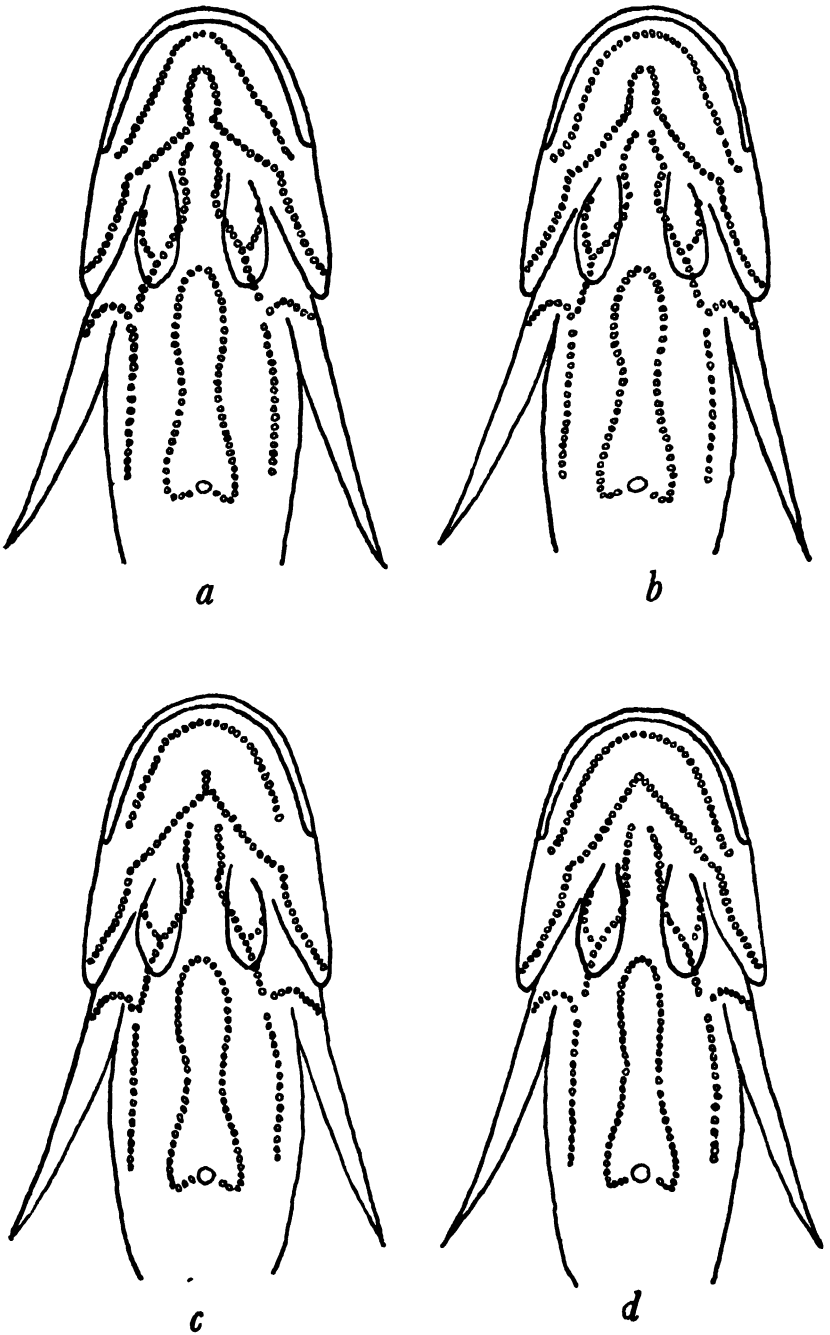


FIGURE 57.—Diagrams of the under side of the head and anterior portion of the body illustrating the courses of the photophores in : *a, Nautopaedium porosissimum; b, Porichthys myriaster; c, P. greenei; d, P. margaritatus.*

and figure of *Batrachus margaritatus* probably represent this species, although the anal rays are given as only 26 and the 8 dorsal saddles are indicated as merely dusky and as not being interspersed by smaller spots. Nor are any small spots shown on the top of the head. The marginal spots on the soft dorsal are barely indicated. In these respects this original account of *margaritatus* agrees better with the specimens discussed already as *Porichthys* species. The anal-ray count was likely an error, however, and the discrepancies in coloration are likely attributable to the small size (3.75 inches) of the type of *margaritatus*. The figure clearly shows the disconnected vertical fins and the simple V-shaped pattern of the branchiostegal photophores characteristic of *margaritatus* (also *analis* and *notatus*) as contrasted with *greenei*.

One of the best distinctions between this species and *P. notatus* lies in its longer pleural row of photophores, which, instead of ending abruptly above end of second third of anal base, is continued backward nearly to the end of the fin. This same arrangement was noted by Greene (1899, p. 676) for the 3 specimens from Alaska that he referred to *notatus*. Unless these are examples of *margaritatus* with erroneous data, they would seem to represent an undescribed species. We have seen no specimens of *Porichthys* from Alaska, and the only record for Alaska we have found is that of Sitka, given by Starks and Morris (1907, p. 230) as the northern limit of range for *notatus*.

The 6 specimens from La Paz Bay, near Cape San Lucas, agree well with the series at hand from Panama, Colombia, and Galapagos. In 3 specimens from Indefatigable Island, 65 to 89 mm long, there are about 7 bands, without intermediate dark mottlings. The dark mottlings in the vicinity of the first dorsal are inconspicuous.

The following collections of *Porichthys margaritatus* in the National Museum have been examined: U.S.N.M. nos. 41145 and 41164, from lat. 7°56′ N., long. 79°41′30″ W.[4]; 41161, Indefatigable Island[4]; 41192, La Paz Bay, Mexico; 41287, Pacific [Panama ?]; 41491 and 41492, from 7°57′ N., 78°55′ W.[5]; 101726, Pinas Bay; 101727 and 101728, Pinas Bay, north of first small island, coarse sand; 101729, Port Utria, Colombia; 101730, Port Utria, Colombia, mud; 101731, Pinas Bay, Bight of Bay, Panama, sticky mud; 101736, Gorgona Island, Colombia, near Gorgonilla Channel; 101737, north end, Gorgona Island, Colombia.

The following collections of *Porichthys margaritatus*, in the Natural History Museum of Stanford University, have been examined: No. 227, Indefatigable Island[5]; 5849, Indefatigable Island.

[4] Listed as types of *P. nautopaedium*.
[5] Listed as cotypes of *P. nautopaedium*.

PORICHTHYS GREENEI Gilbert and Starks

FIGURE 57, *c*

Porichthys sp. GREENE, 1899, pp. 668, 678 (description of photophores in types).
Porichthys greenei *GILBERT and STARKS, 1904, pp. 184–185, pl. 30, fig. 56 (original description).—BEAN and WEED, 1910, pp. 511, 513, 515, 516, 526, figs. 3, 4, pl. 32, fig. 4 (opercular spine, pectoral fin; one of types of *Thalassophryne dowi* is this species).—*MEEK and HILDEBRAND, 1928, pp. 922, 924–925 (description, records). (Type locality: Tide pools; Panama reef.)

Should the genus *Porichthys* be further dismembered, this small species would probably be the first to be set apart, on the basis of the conjoined vertical fins, the usually simple (nonfimbriate) pores of the lateral lines, the lack of minute photophores about the pores of the dorsal branch of the lateral line, the short median branch extending forward from the apex in the branchiostegal row of photophores, and the rounded pectoral fin.

The following collections of *Porichthys greenei* in the National Museum have been examined: U.S.N.M. no. 76548, Panama Canal, Panama City; 81689 and 81690, tide pool, Panama; 81691 and 81692, tide pools, Balboa, Canal Zone; 81693, Panama Bay, Balboa, Canal Zone; 81965, Chame Point, Panama; 101732, 101733, and 101946, all from Secas Isle, Panama.

The following collections of *Porichthys greenei* in the Natural History Museum of Stanford University have been examined: No. 6485 (type), Panama reef; 6512, Panama.

Genus NAUTOPAEDIUM Jordan

Nautopaedium *JORDAN, 1919, p. 342 (diagnosis).

Orthotype.—"*Porichthys plectrodon* Jordan and Gilbert=*Batrachus porosissimus* Cuv. & Val."

We follow Jordan in distinguishing generically between the single Atlantic species and the several Pacific forms commonly referred to *Porichthys*. The prime difference lies in dentition. In *Porichthys* the palatine and premaxillary teeth as usual in fishes are directed slightly backward, whereas in *Nautopaedium* the palatine teeth are directed forward in the adults of both sexes and the posterior premaxillary teeth are directed forward in the adult male. Both the palatine and the premaxillary teeth are much more enlarged in the adult male than in *Porichthys*. The few (usually 3 to 6) developed palatine teeth are confined to the front of the bone, instead of being spread along the entire edge. Meek and Hildebrand (1928, p. 922) did not accept the genus, and we do not regard it as very trenchantly distinct.

The marked age variations and sexual dimorphism in the teeth of *Nautopaedium porosissimum* largely explain the discrepancies in published descriptions.

NAUTOPAEDIUM POROSISSIMUM (Valenciennes)

FIGURE 57, *a*

Batrachus porosissimus *VALENCIENNES, *in* Cuvier and Valenciennes, 1837, pp. 501–506 (original description; pre-Linnaean synonymy).—Jenyns, 1842, pp. 99–100 (Bahia Blanca).

Porichthys porosissimus *GIRARD, 1855a, p. 141 (new combination).—*GÜNTHER, 1861, pp. 176–177 (*margaritatus* and *notatus* as synonyms, description).—*KNER, 1865, pp. 190–191, pl. 8, figs. 1, 1a (description; Rio de Janeiro).—JORDAN and GILBERT, 1882b, p. 291 (comparison); 1883a, pp. 751–752 (description; in part).—*JORDAN, 1884a, p. 291; 1884b, p. 41; 1995b, p. 116 (teeth, range; *plectrodon* as synonym).—*MEEK and HALL, 1885, pp. 56–57 (teeth, synonymy).—JORDAN and SWAIN, 1885, p. 545 (Pensacola, Fla.).—JORDAN, 1886, p. 229 (eaten by red snappers, Snapper Banks, Fla.).—PERUGIA, 1891, p. 620 (Montevideo).—BERG, 1895, pp. 69–70 (synonymy; in part; South American records).—REED, 1897, p. 661 (Chile by error, *fide* Delfin, 1901, p. 89).—*JORDAN and EVERMANN, 1898, p. 2319 (description, synonymy); 1900, p. 3301, pl. 335, fig. 811.—JORDAN, 1905, vol. 2, p. 526, fig. 481.—REGAN, 1914, p. 23 (off Cape Frio, Brazil).—RIBEIRO, 1915, pp. 1–4 (description; Rio de Janeiro).—DEVINCENZI, 1924, p. 258 (diagnosis; Uruguay).—*MEEK and HILDEBRAND, 1928, pp. 922–923 (description, synonymy, records).—BREDER, 1929, p. 266 (diagnosis, range). (Type locality: "De Surinam . . . Cayenne . . . Rio Janéiro . . . et de Sainte-Catherine, du Brésil"; commonly given as and hereby restricted to Surinam.)

Porichthys plectrodon GOODE and BEAN, 1882, p. 236 (*nomen nudum*; Gulf of Mexico).—*JORDAN and GILBERT, 1882b, p. 291 (original description); 1883a, p. 958 (diagnosis; South Carolina to Texas); 1883b, pp. 616, 620 (Charleston, S. C.). (Type locality: Galveston, Tex.)

The anal rays in *N. porosissimum* have been variously counted by different authors. In 24 specimens we count the dorsal and anal rays as indicated in table 4.

The following collections of *Nautopaedium porosissimum* in the National Museum have been examined: U.S.N.M. no. 30894, Galveston, Tex. (types of *Porichthys plectrodon*); 32801, Pensacola, Fla.; 39375 and 39376, lat. 28°50′ N., long. 83°00′ W., northwest end, St. Martins Reef, Fla.; 39877, off Cape Sable, Fla.; 44667 and 45995, from 10°37′40″ N., 61°42′40″ W.; 45751 and 45996, 33°20′ N., 77°05′ W., or 33°18′30″ N., 77°07′00″ W.; 47638, Alacran Shoals; 73040, off Northwest Channel, Fla., 24°40′45″ N., 81°53′40″ W.; 73041, Hawk Channel, Fla.; 73042, Pigeon Key Lake, Fla.; 73043, Pepperfish Key, Fla.; 73044, 29°48′10″ N., 83°55′15″ W.; 73045, Deadmans Bay, Fla.; 73046, off Key West, inside reef, Fla.; 73047, North Key, Fla.; 73048, Key West, Fla.; 73049, Deadmans Bay, Fla.; 73050, Pepperfish Key, Fla., 29°33′05″ N., 83°23′03″ W.; 83164 and 83168, from Rio de

Janeiro; 83833, 34°35′30″ N., 75°45′30″ W.; 83834, 34°38′00″ N., 76°12′00″ W.; 86118, Palma Sola, Fla.; 86740, coast of Uruguay; 87722, outside of bay, Rio de Janeiro; 87723, Uruguay; 87753, Santos [Barro]; 94375, off Cape Henry, Va.; 94549, Corpus Christi, Tex.; 100882, market at Santos, Brazil.

The following collections of *Nautopaedium porosissimum* in the Museum of Zoology, University of Michigan, were examined: No. 95501, Necochea, Argentina; 110159, off Englewood, Fla.; 105490, near Horn Island, Miss. (shrimp trawl).

The following collection of *Nautopaedium porosissimum* in the Natural History Museum, Stanford University, was examined: No. 9568, 10°37′40″ N., 61°42′40″ W.

TABLE 4.—*Dorsal and anal ray counts in* Nautopaedium porosissimum

Rays	Number of rays							
	31	32	33	34	35	36	37	38
Dorsal	------	------	1	4	12	5	------	1
Anal	4	11	7	1	1	------	------	----

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A NEW GENUS OF STARFISHES FROM THE ALEUTIAN ISLANDS

By Austin H. Clark

During the summer of 1937, Dr. Victor B. Scheffer, of the United States Bureau of Biological Survey, made an unusually extensive collection of shallow-water echinoderms in the Aleutian Islands. Among the starfishes included were two very small 6-rayed individuals, one from Attu and the other from Amchitka, that at first sight appeared to represent a species of *Pteraster*. Closer examination revealed the fact that they are assignable to the Ganeriidae, although they are quite different from any of the other forms included in that family.

The family Ganeriidae includes the genera *Ganeria*, *Lebrunaster*, *Radiaster*, *Scotiaster*, *Cycethra*, *Kampylaster*, and *Leilaster*. Of these six genera two, *Radiaster* and *Leilaster*, are known only from the West Indies in water of from slight to great depth; all the others live in the Antarctic or immediately adjacent regions. It is especially interesting, therefore, to find a member of this family in the North Pacific.

ALEUTIASTER, new genus

Diagnosis.—A genus of Ganeriidae in which the superomarginals are absent; the inferomarginals, which are but little larger than the plates of the abactinal surface, are decumbent outwardly and broadly imbricating; and the actinal plates consist of a single row not quite reaching the arm tips, with a second irregular row traceable to about the middle of the arm; hexamerous.

Genotype.—*Aleutiaster schefferi*, new species.

Habitat.—Aleutian Islands; 1–7 fathoms.

Remarks.—At first I regarded *Aleutiaster* as most closely related to *Perknaster*, later deciding that its affinities were rather with *Cycethra*. I have never been able to examine a specimen of any species of *Perknaster*, which I know only from descriptions and figures.

Prof. Walter K. Fisher, who examined the two specimens of *Aleutiaster schefferi*, writes that he is of the opinion that *Aleutiaster* is a little nearer to *Perknaster* than to *Cycethra*—or possibly the three genera may be placed at the three apices of a triangle.

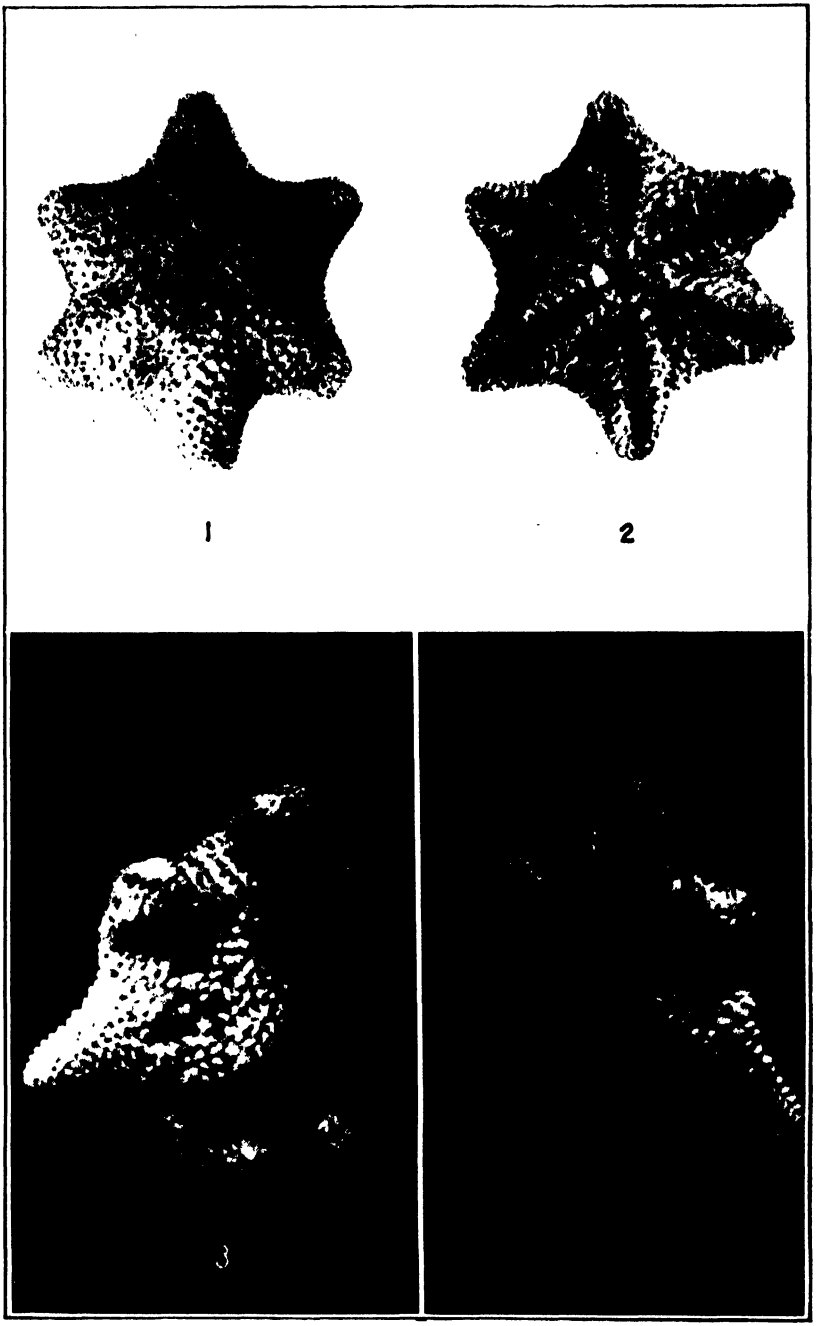
Both the specimens of the type species of *Aleutiaster* are very small and possibly immature, but their characters are so distinctive that even if the adults should prove to be much larger they will be readily recognizable.

ALEUTIASTER SCHEFFERI, new species

PLATE 57, FIGURES 1–4

Description.—A very small species with six short arms, perhaps better described as hexagonal with obtuse reentrant angles. The abactinal surface is elevated, having a somewhat inflated appearance, and the abactinal side passes over in a broad curve to the flat actinal surface. The entire animal is covered with a thick skin, which completely conceals the underlying plates. The spines are enclosed in skin sacks, and the adambulacral spine combs are webbed. The resemblance at first glance to a small *Pteraster* is striking. R=5 mm.; r=3.5 mm. R=about 1.4 r. Height at center, 3.5 mm. (=r).

The plates on the abactinal surface are very thin, scalelike, glassy, and very strongly imbricating. Those in the center are circular to broadly 4- or 5-lobed, or more or less elongate; those on the arms are broadly and roundedly wedge-shaped. Each plate has an abruptly thickened and roundedly elevated opaque portion that stands high up from the glassy scalelike base. This elevated portion is central on some of the plates on the disk, but on the plates on the arms it involves the adcentral half, or rather less; on these plates it is somewhat elongate transversely and commonly has a slightly concave thickened adcentral border. Interradially as the abactinal passes into the actinal surface the plates become elongate-triangular with the swollen narrow base away from the mouth. In the central portion of the abactinal surface the plates are somewhat irregular in arrangement, but on the arms they become arranged in diagonal lines. The greater portion of each plate is concealed beneath the plate following, so that the abactinal surface seems to be covered by the thickened and elevated portions of the plates, slightly



ALEUTIASTER SCHEFFERI, NEW GENUS AND SPECIES.

1, 2. The type specimen from Attu, abactinal (1) and actinal (2) sides. × 5.
3, 4. The specimen from Amchitka, abactinal (3) and actinal (4) sides. × 5. One ray has been denuded to show the plates.

separated from each other, all standing on a uniform filmy calcareous body investment. In the center of the abactinal surface the imbrication of the plates is more or less outward, but this soon changes so that the plates on the upper surface of the arms imbricate toward the center of the animal, those on the sides of the arms becoming somewhat oblique and those adjoining the marginals imbricating at right angles to them, toward the midline of the arms. In each interradius, about midway between the center of the disk and the interradial angle, there is a single large circular plate with a central elevated boss, which, except for the boss, is entirely concealed by the overlapping of the surrounding plates.

The elevated portion of each plate bears 1 to 10, usually 4 to 6, short spinelets situated irregularly about its summit, leaving a more or less conspicuous central area bare. These spinelets may or may not be in contact basally. They are cylindrical with roughened or denticulate tips and are short and rather stout, three or four times as long as thick. The groups of spinelets are well separated from one another. In the actinal interradial areas the groups of spinelets tend to become elongated and to be arranged in irregular rows.

There is no madreporic body, and superomarginals are absent.

A series of 13 inferomarginals runs from the interradial angle to the arm tip. These are triangular, with the apex of the triangle toward the arm base and the outer portion, which broadly overlaps the base of the inferomarginal succeeding, much swollen. Only the swollen outer portion is visible, so that the inferomarginals appear as much swollen, broadly rounded plates about twice as high as long. They are somewhat larger than the plates just above them and are distinguished particularly by their radial, instead of transverse, imbrication. They bear 5 to 8 spinelets in a double row.

Between the inferomarginals and the adambulacral plates, and connecting the two series, is a series of very small actinal intermediate plates that runs to the arm tip. The basal four or five of these plates carry a single spine; the others are without spines. As far as the eighth adambulacral plate a row of very minute plates alternates with these at their inner ends. Opposite the proximal six adambulacral plates the actinal intermediate plates become larger, and in the interradial angles between these and the inferomarginals there are about half a dozen small irregularly arranged additional plates.

There are 18 fully developed adambulacral plates along each side of the ambulacral groove. These are about three times as broad as long, project well above the general surface, and are separated from one another by their own width or more.

On the first four to six adambulacral plates there is a pair of spines of about the same size, one proximal and one distal, next the furrow. At right angles to these, and to the furrow, are at first two, then three, slightly smaller spines forming a comb. Beyond the fourth to sixth adambulacral plate the distal spine of the pair next the furrow moves downward and inward toward the furrow to a position in line with the other spines, so that a comb of five echinate spines is formed of which the innermost, at the edge of the ambulacral groove, is slightly longer and stouter than the others, and the outermost is slenderer.

The mouth plates are large and triangular. The outer ends, adjoining the adambulacrals, make an angle of about 45° with their inner opposed borders, and the length is about three times the greatest width. The pair of mouth plates dips downward toward the mouth, the inner surface rising toward the tip and toward the outer borders. Each plate bears on its long outer side four cylindrical spines resembling those on the adjacent adambulacrals, with a larger and more tapered spine at the inner angle and a smaller one on the inner portion of the distal border.

The tube feet are in two rows.

Localities.—Attu, Aleutian Islands; 2–7 fathoms; sandy bottom; Victor B. Scheffer, June 10, 1937 (type, U.S.N.M. no. E. 5600; original no. 44). (Pl. 57, figs. 1, 2.)

Amchitka, Aleutian Islands, 1–5 fathoms; Victor B. Scheffer, July 19, 1937 (1, U.S.N.M. no. E. 5601; original no. 9). (Pl. 57, figs. 3, 4.)

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ELEVEN NEW SPECIES AND THREE NEW GENERA OF OCEANIC FISHES COLLECTED BY THE INTERNATIONAL FISHERIES COMMISSION FROM THE NORTHEASTERN PACIFIC

By WILBERT MCLEOD CHAPMAN

DURING the past 10 years the International Fisheries Commission has conducted extensive macroplankton work in the northeastern Pacific Ocean in their investigation of the early life history of the halibut. Incidental to the taking of eggs and young stages of halibut a wealth of other ichthyological material has been amassed, consisting of eggs, young stages, and adult specimens of a great many species of fishes. The present report is a study of the pelagic and bathypelagic fishes in the collection that are new to science.

I am indebted to Dr. W. F. Thompson, director of investigations, International Fisheries Commission, and director of the School of Fisheries, University of Washington, for permission to work on these fishes. Dr. L. P. Schultz, of the United States National Museum, gave much helpful advice. The work was done in the laboratories of the International Fisheries Commission and the School of Fisheries, University of Washington, while I was a student at the latter institution. Appreciation is expressed for the use of facilities of the two institutions. Tables giving the individual measurements and counts for each specimen reported upon are to be found in doctorate thesis no. 317884 in the University of Washington Library, Seattle, Wash. The holotypes and some of the paratypes of the new species are deposited in the United States National Museum. The other specimens are in the collection of the International Fisheries Commission, Seattle.

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LOCATION OF STATIONS

In the years 1926 to 1934, 2,246 net hauls were made at 1,161 stations in the northeastern Pacific by the International Fisheries Commission (hereafter referred to as the IFC). The area covered extends from off Cape Flattery, Wash., to the Sanak Islands, Alaska. It includes the coast of British Columbia and Alaska to the entrance of Bering Sea and extends throughout the Gulf of Alaska north of latitude 54° N.

Since the work was done to capture eggs and larvae of halibut, it covered principally only that time of year when they were to be expected in the plankton, that is, from January 1 to July 28. No stations were worked at any other time of the year. In the period January through March, stations were worked in 1928, 1929, 1930, 1932, 1933, and 1934. During this season the area around the Queen Charlotte Islands, especially in the vicinity of the Whaleback, Cape St. James, and the entrance to Hecate Strait was very well covered, as was also the northern part of the Gulf of Alaska from Yakutat to Cape Chiniak on Kodiak Island. No stations were worked west of that point. Stations were also worked farther out in the Gulf of Alaska, and a few off Cape Flattery, Wash. From April 1 to May 21, stations were worked in 1929, 1930, 1931, and 1932. The area around the Queen Charlotte Islands was again well covered. Many stations were worked across the Gulf of Alaska between latitudes 54° N. and 58° N. A few in the vicinity of Yakutat were the only ones worked in the northern part of the Gulf during this period. The area from Cape Chiniak to the Shumagin Islands was well covered. No stations were worked south of Queen Charlotte Sound. In the third period, between May 22 and June 27, stations were worked in 1931 and 1932. During this season no net stations were worked in the vicinity of the Queen Charlotte Islands or southward. Several lines of stations were run across the middle of the Gulf of Alaska to Kodiak Island. Another series was taken to the southwest of Kodiak Island, between it and the Alaskan Peninsula. A number of stations made in 1931, in the latter part of June and in July, were worked between Kodiak Island and the Sanak Islands.

The "standard" stations were made as follows: Three 1-meter nets were put on the wire at intervals of 300 meters. The wire was then played out until the bottom net was 900 meters from the boat. After being towed at slow speed for 20 minutes, 100 meters of wire were brought in. After another interval of 20 minutes the nets were raised another 100 meters. When the nets had been towed at these depths for another 20 minutes they were hauled to the surface. Their contents were removed and immediately preserved in 4 percent formalin. Thus the "A" nets were towed for 20 minutes at each of

100, 200, and 300 meters; the "B" nets at 400, 500, and 600 meters; and the "C" nets at 700, 800, and 900 meters. Collections at 344 of the stations were of this type. At times other nets were added below when the depth of the water permitted. At other times, when the boat was over shallower water, the bottom net, and sometimes also the "B" nets, were omitted. When towing over shallow water, the depth intervals of the nets were often altered to conform with the contour of the bottom. The time that they were towed at each depth was then nearly always one hour. Some vertical hauls were also made both with the regular open nets and with closing nets. This type of haul yielded very few fish.

All the "standard" hauls were made with 1-meter nets of the same type. These were nets, 1 meter in diameter at the mouth, made of silk 24 meshes to the inch in the cone and 14 to the inch in the cylinder. This type of net was used as the standard for the winter work because of the ease with which it could be handled in stormy weather and its relative efficiency. In smooth weather hauls were sometimes made with nets 2 meters in diameter at the mouth made of silk grit gauze, and Petersen Young fish trawls constructed out of quarter-inch mesh cotton netting. These latter were sometimes hauled at depths as great as 1,500 meters and caught many deep-sea fishes. Another type of net, the Danish trawl, was used extensively in 1931. It was a cone of "stramin" cloth hung on a hoop about 7 feet in diameter. It also yielded many fish.

DEPTH OF CAPTURE

Because of the fact that the hauls were made with open nets, it is not possible to determine accurately the depth at which any individual specimen was captured, for presumably the nets fished both on the way down and up. The bottom nets, therefore, had an opportunity to catch fish in the surface and intermediate levels as well as at the depths they were supposed to fish. This would not have been the case had closing nets worked satisfactorily. Unfortunately, the closing nets were unsuccessful as captors of adult fish. Furthermore, although a heavy weight was attached to the end of the wire, it did not hang straight down in the water. The IFC has used 85 percent of the length of wire out as an approximation of the depth at which the net was fishing. An effort was made to keep the cable at a constant angle, but in the stormy weather and strong tidal currents prevalent at times in the area covered it was impossible always to do so. It turned out, however, that an approximation could be made of the vertical distribution of several species because, although an individual would perhaps be caught during the short period of raising or lowering, it was safe to assume that numbers were taken only during the actual

horizontal haul. Some species were taken only in the "C" nets or in only the "C" and "B" nets, while others were captured only by "A" nets or "B" and "A" nets. The approximate vertical distribution of each species is discussed in the "Systematic Account."

It is interesting to note that many of the species are limited in their distribution to the open ocean where the water is 100 fathoms or more deep, even though they may be taken in the upper layers. Off the west coast of the Queen Charlotte Islands, especially in the vicinity of Cape St. James and the outer part of Queen Charlotte Sound, the bottom shelves off rapidly until only a few miles from shore it is over 1,500 fathoms deep. It was in this area that many of the most interesting fish were taken. This peculiarity of distribution cannot be attributed to the manner in which the hauls were distributed because as many or more stations were made over shallow water as were taken over deep water. Nevertheless, fish that were taken frequently in the shallow nets over deep water were never taken in nets hauled at the same levels over shallow water. They, therefore, must occupy normally a typically pelagic or bathypelagic habitat. This is discussed under each species in the text.

A complete description of each of the stations worked can be found in Report No. 9 of the International Fisheries Commission (Thompson and Van Cleve, 1936, table 16, pp. 134–160).

DEFINITIONS OF TERMS USED

In the descriptions of the luminescent organs of the Iniomi the terminology adopted by Parr (1928, pp. 50 and 51, fig. 6) has been used. The term "photophore" designates those circular or ovoid luminescent organs that appear in the regular series on the body, or the similar organs on the head in distinction to the other type of luminous organ, the so-called luminous scales and plates. The regular series of photophores on the body are defined as follows:

PLO=Suprapectoral organ, macula suprapectoralis, found usually between the base of the pectoral fin and the lateral line.

PVO=Subpectoral organs, maculae subpectoralis, between the base of the pectoral fin and the PO series.

PO=Thoracic organs, maculae pectoralis, along the ventral line between the isthmus and the base of the ventral.

VLO=Supraventral organ, macula supraventralis, between the base of the ventral fin and the lateral line.

VO=Ventral organs, maculae ventralis, between the base of the ventral fin and the first rays of the anal fin, on the ventral line.

SAO=Supra-anal organs, maculae supraanalis, between the anus and the lateral line.

AO=Anal organs, maculae analis, along the base of the anal fin, often divided by a distinct gap into two series, the antero-AO=antero-anal organs, maculae analis anteriores, and postero-AO=postero-anal organs, maculae analis posteriores.

POL=Posterolateral organ(s), macula(e) posterolateralis, between the lateral line and the gap between the two series of AO.

PRC=Praecaudal organs, maculae praecaudalis, along the base of the lower lobe of the caudal fin and along the posteroventral surface of the caudal peduncle.

The series of luminous scales along the dorsal and ventral side of the caudal peduncle in some of the fishes are called respectively the *supracaudal* and *infracaudal* series.

In treating the stomiatoid fishes the luminescent organs of the lateral, ventral, and caudal series have been described (after Parr, 1927, p. 23, fig. 19) as follows:

The upper, or lateral, series is divided into—

O–V=Photophores present between the gill opening and a perpendicular from the base of the ventral fin.

V–A=Photophores between the perpendicular from the base of the ventral and the beginning of the single caudal series (A–C).

The lower, or ventral, series is divided into—

I–P=Photophores anterior to the base of the pectoral fin.

P–V=Photophores between the bases of the pectoral and ventral fins.

V–A=Photophores from below the base of the ventral to the beginning of the single caudal series (the A–C).

The "length" in the descriptions is, unless specifically stated otherwise, the straight line from the tip of the snout to the bases of the middle rays of the caudal fins, the "length without caudal."

The "proportions of length" in the descriptions are the result of dividing the particular measurement of the body into the length without caudal.

SYSTEMATIC ACCOUNT

Order ISOSPONDYLI: Suborder SALMONOIDEI

Family BATHYLAGIDAE

Genus BATHYLAGUS Günther, 1878

BATHYLAGUS ALASCANUS, new species

FIGURE 58

Types.—The holotype, a specimen 83 mm long without caudal taken at station 444C, June 13, 1931, latitude 58°25′ N., longitude 146°04′ W., U.S.N.M. no. 108148, and 35 paratypes ranging from 27 to 81 mm in length without caudal taken at the following stations[1]: 4B; 6C; 12B; 21C; 184B; 189B; 218C; 234B; 236B; 256B; 258C; 267B; 290C; 293C; 303C; 324C; 326C; 336C; 338B; 384C; 391D; 407B; 447D.T.; 450C; 455D.T.; 456C; 457D.T.; 493D.T.; 495D.T.; 622C; 636C; 639C; 764B; 1116B.

[1] For data on stations listed in this paper see Report No. 9, International Fisheries Commission (Thompson and Van Cleve, 1936, table 16, pp. 134–160).

The paratypes in the United States National Museum bear the numbers 108151–108156.

Description.—(The proportions and counts of the holotype are given, followed by the ranges and averages of the paratypes in parentheses.) Dorsal rays 8 (7 to 9; 7.7); anal rays 24 (23 to 27; 24.3); caudal rays 51 (46 to 56; 50.8); pectoral rays 14 (13 to 14; 13.9); scales in lateral series 25 (23 to 27; 24.6). Proportions of the length without caudal: Length of head 3.4 (3.2 to 4.0; 3.59); snout to dorsal 1.8 (1.8 to 2.3; 2.01); snout to adipose 1.2 (1.1 to 1.3; 1.20); snout to pelvics 2.0 (1.9 to 2.4; 2.0); snout to anal 1.4 (1.3 to 1.6; 1.55); greatest depth 4.4 (4.2 to 6.2; 5.46); origin of dorsal to base of caudal 2.0 (1.6 to 2.1; 1.90); origin of anal to base of caudal 3.1 (2.5 to 3.1; 2.82); dorsal to adipose 2.9 (2.5 to 3.1; 2.82). Proportions of the length of head: Diameter of eye 2.6 (2.2 to 2.8; 2.59); length of upper jaw 6.2

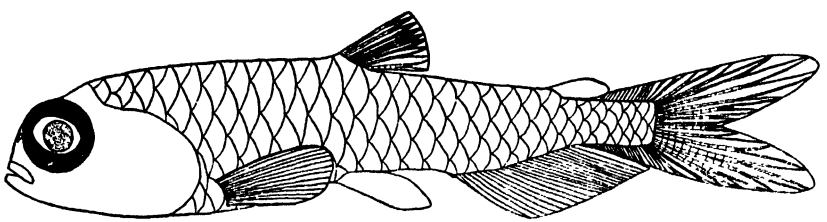


FIGURE 58.—*Bathylagus alascanus*, new species: Holotype (U.S.N.M. no. 108148), 83 mm long, from station 4440.

(3.2 to 6.7; 4.43); depth of caudal peduncle 4.4 (3.2 to 5.0; 4.16); interorbital space 3.7 (3.1 to 6.5; 4.34). Some of the proportions shown above vary considerably. Part of this variation is due to the changing of the body proportions during growth. The small number of specimens does not permit a statement of the degree of this change. Some part of this variation is due also to difficulties in measuring the soft small specimens accurately.

The body is completely clothed with large caducous scales. The eyes are large and circular, projecting slightly into the dorsal outline. The interorbital space is decidedly concave. The snout is short. The mouth is small. The maxillary reaches nearly to a vertical from the anterior edge of the lens of the eye. The teeth on the dentaries are small and sharp, in a single closely packed row. There are four moderately large teeth on the head of the vomer, and none on the shank or on the palatines, premaxillaries, maxillaries, or tongue. The lower jaw projects slightly. The origin of the dorsal fin is, in most specimens, a little ahead of the middle of the body. The adipose originates over the sixteenth or seventeenth ray of the anal, with the distal portion extending over the second or third caudal ray. The

free lobe is proportionately large. The pectorals are inserted low and have broad and nearly vertical bases. The rays reach a vertical from the ventral when depressed. The ventrals are inserted under the third or fourth ray of the dorsal. The caudal rays extend anteriorly along the caudal peduncle until there is only a slight space left between them and the adipose above and the anal below.

Remarks.—The only species in the genus with which this form could be confused is *Bathylagus milleri* Jordan and Gilbert (Jordan and Evermann, 1896–1900, p. 2825). In the original description of that species, based on a single badly mutilated specimen, the dorsal rays are given as 8 and the anal rays as 24, both of which are within the range of *B. alascanus*. However, it was stated that the origin of the dorsal is nearer the base of the caudal than the tip of the snout. Out of 28 specimens of *B. alascanus* 18 specimens have the origin of the dorsal nearer the tip of the snout than the base of the caudal, 6 have it equidistant between them, and 4 have the origin of the dorsal closer to the base of the caudal. It is also stated that in *B. milleri* "the interorbital space is converted into a very deep channel by two vertical thin lamellae which arise on either side and mark off the narrow interorbital space from the contiguous supraocular areas." In *B. alascanus* the interorbital is only moderately concave. In fact, in the smaller specimens, such as that from station 1116B, the interorbital space is flat, sloping forward. The concavity of the large specimens is caused by the expansion dorsally of the large eyes. In *B. milleri* the occipital region is swollen and prominent, much higher than the interorbital space. In *B. alascanus* the occiput is normal, and slopes gradually to the interorbital space. In view of these differences, the sketchy description of *B. milleri*, the badly mutilated condition of the type specimen of that species, and the striking differences of *B. alascanus* from the other species in the genus, it is described as new.

The locations of the stations at which this form was taken show a range for *B. alascanus* extending from off Cape St. James (southern tip of Queen Charlotte Islands) throughout the Gulf of Alaska to south of the Shumagin Islands. All the specimens except three were taken outside the 100-fathom line. These three, at stations 218C, 338B, and 407B, were taken on the edge of the 100-fathom line. None of the specimens taken in the standard hauls was taken in the "A" nets, 12 were taken in "B" nets, 17 were caught in the "C" nets. Only one specimen (from station 391D) was taken in a surface net. These data would indicate a bathypelagic habitat, outside the edge of the continental shelf, as normal for this species.

Named in reference to its habitat, the Gulf of Alaska.

MACROPINNIDAE, new family

Diagnosis.—Stomiatoid fishes with an adipose fin. The ventral fins are abdominal, situated on the side of the body above the ventral outline, and with very elongate rays, reaching to, or beyond, the base of the caudal. The anal fin is normal as long as or longer than the dorsal, and well separated from the caudal fin. The anus opens somewhat ahead of the origin of the anal. The ventral surface is normally rounded. There is no flat ventral "sole," with an anterior projection below the head. The eyes are cylindrical, pointing directly upward. They are covered with dense black pigment laterally and anteriorly so that vision can be only vertical. The maxillaries are present, broadly expanded posteriorly. The gape is minute. The opercle is small and ovoid, with its longest diameter only a little more than its shortest. It does not project below the level of the pectoral base. The subopercle is only a little smaller than the opercle and is of the same general shape. The body is short and stubby; the head is large. There are no luminous spots on the body or head. There is no mental barbel.

This family of peculiar fishes appears to be somewhat related to the Opisthoproctidae, which are found in the eastern Atlantic (Vaillant, 1888; Zugmeyer, 1911a and b; and Roule and Angel, 1933); the western Atlantic (Gregory, 1933); and the western Pacific in the South China Sea (Trewavas, 1933). No fish remotely resembling the present species has been described from the eastern Pacific. From the Opisthoproctidae they differ strikingly in the presence of a maxillary (absent in the Opisthoproctidae), which is broadly expanded posteriorly; by the perfectly normal anal fin, which is larger than the dorsal, and the normally placed anus (in the Opisthoproctidae the anus opens posteriorly near the base of the caudal fin; the anal fin is normally atrophied, and is either very small and only slightly separated from the caudal or is so closely appressed to the latter that it appears to be absent); by the differences in the size and shape of the opercle and subopercle (the Opisthoproctidae have the opercle long and narrow; the subopercle is very small and is almost hidden by the preopercle); by the lack of a ventral "sole" (this peculiar structure, characteristic of the Opisthoproctidae, consists of a flattened ventral surface which projects more or less beyond the normal outline under the head and is supported by the anterior arm of the cleithrum); by the position and extreme length of the ventral and pectoral fins (in the Opisthoproctidae the ventral fins project into the ventral outline and are of normal length); and by numerous other peculiarities (see Trewavas, 1933). The Macropinnidae, however, resemble the Opisthoproctidae in the small gape, the general shape of the body, the presence of an adipose fin, and the dorsally directed eyes.

MACROPINNA, new genus

Genotype.—Macropinna microstoma, new species.

The characters of the genus are those of the species.

MACROPINNA MICROSTOMA, new species

FIGURE 59

Types.—The holotype, a specimen 39.5 mm long from station 621C, collected March 28, 1932, latitude 53°50′ N., longitude 134°20′ W., U. S. N. M. no. 108143, and 27 paratypes from the following stations: 7B; 25C; 122A; 132A; 132B; 192; 207A; 245C; 260C; 268B; 293B; 334C; 339A; 396A; 407C; 410A; 412A; 434A; 491D.T.; 546D.T.; 593B; 621C; 626B; 627B; 817A; 953C; 1017C; 1113A.

Those paratypes in the United States National Museum bear numbers 108177–108185.

Description.—Twenty-eight specimens of this species are in the IFC collection, ranging in length without caudal from 6.5 to 39.5 mm. The specimen from station 621C is taken as the holotype, with the other 27 as paratypes. Its counts and bodily proportions follow: Dorsal ray 11; anal rays 14; caudal rays 40; pectoral rays 17; ventral rays 10; number of scales in the lateral line 24. Length without caudal 39.5 mm. Proportions of the length without caudal: Length of the head 2.0; snout to dorsal origin 1.4; snout to adipose 1.1; snout to insertion of ventrals 1.3; snout to origin of anal 1.4; greatest depth 2.7. Proportions of the length of the head: Diameter of eye 2.8; length of upper jaw 5.6; least depth of caudal peduncle 3.9; length of caudal peduncle 3.9.

A second adult specimen from IFC station 407C had the following counts and proportions: Dorsal rays 11; anal rays 14; caudal rays 10; pectoral rays 18; ventral rays 10; scales along the lateral line 26. Length without caudal 27.5 mm. Proportions of the length without caudal: Length of the head 2.1; snout to dorsal origin 1.4; snout to adipose 1.1; snout to insertion of ventrals 1.8; snout to origin of anal 1.4; greatest depth 3.2. Proportions of the length of the head: Diameter of eye 2.6; length of the upper jaw 4.3; least depth of caudal peduncle 3.7; length of caudal peduncle 3.7.

The body is deep and short, quite unlike the slender form of the smaller specimens. It appears to have been completely covered by large cycloid scales, although only those along the lateral line remain on the holotype. The snout is broad, flat, and shovellike. It is U-shaped in dorsal aspect. The eyes are not round, but are cylindrical, with the pupils pointing directly upward so that the cornea projects into the dorsal outline. They are completely surrounded laterally by a densely pigmented area. Dorsoanteriorly this light

shield bears a dorsal projection which cuts off the light coming from ahead. The region of the head immediately anterior to the eyes is transparent, except for a slight amount of pigment around the openings of the nostrils, which are placed here. The adductor mandibularis, the eye muscles, and the ramifications of the cranial nerves are plainly visible.

The gape is extremely small, not reaching more than a third of the way to the eye. No teeth can be seen on any of the bones of the mouth, although there may be a few minute teeth on the premaxillaries and the dentaries. The specimens remained in formalin until the osseous structures became flabby. The maxillary is short but greatly expanded posteriorly so that it is nearly as broad as it is long.

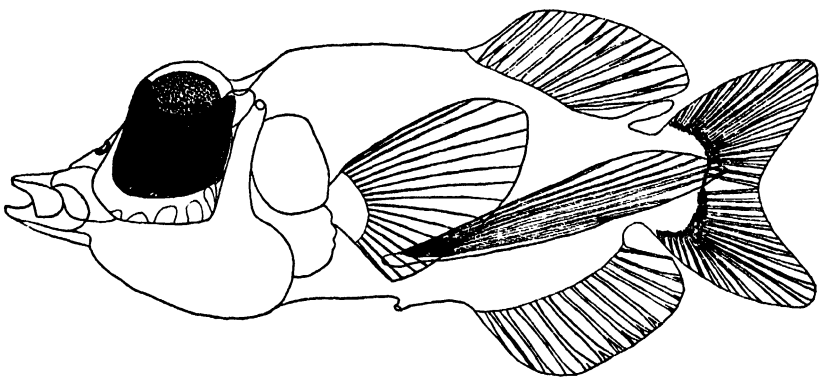


FIGURE 59.—*Macropinna microstoma*, new genus and species: Holotype (U.S.N.M. no. 108143), 39.5 mm long, from station 621C.

The dentary is even more expanded posteriorly than the maxillary. This expanded portion fits in under the maxillary, between that bone and the palatine.

The opercle is oval, with the longest diameter vertical. It is a proportionately small bone. It does not extend below the base of the pectoral fin. The subopercle is a small oval bone about the size of the opercle. The dorsal arm of the preopercle is normal, but the ventral arm is enormously expanded ventrally and is the largest bone in the opercular series. The interopercle is also large and expanded ventrally. It is mostly overlain by the preopercle. It does not reach to the subopercle. The four branchiostegal rays are broad and very thin. The gill rakers are short, broad, triangular, and thin; the gill membranes are broadly united and attached to the isthmus with a broad free fold behind.

The dorsal and anal fins are similar to each other; the former is inserted a little ahead of the latter. The adipose is situated on the caudal peduncle about midway between the end of the dorsal and the first rays of the caudal. The pectoral fins are large and are situated

well up on the body, about midway between the dorsal and ventral outlines. Their rays are fine and long, reaching to the middle of the anal fin. The ventrals are likewise placed high on the body and well forward so that they are only a short way ventral and posterior to the pectoral fins. They are inserted far ahead of the origin of the dorsal. Their rays are moderately stout near their bases and extremely long, reaching beyond the posterior end of the body. Although the caudal fin is frayed, it can be seen that it is distinctly divided into a dorsal and a ventral lobe. The anus opens far ahead of the origin of the anal fin, only a short distance posterior to a vertical from the bases of the ventral fins.

6.5-MILLIMETER STAGE

The specimen from station 817A is the smallest one in the collection. It is 6.5 mm in total length. Unfortunately, like most of the smaller specimens, it is so badly twisted that measurements cannot be accurately made. The head is contained in the total length 2.9 times. The eyes are torn from the sockets, and it is not possible to see how much they point dorsally. There is a small spot of pigment at the nape. Along the posterior half of the dorsal midline there is a row of 14 small pigment spots arranged segmentally. A similar line of pigment extends from the sixth segment behind the vent to the base of the caudal fin. There is a small amount of pigment around the posterior half of the abdomen. The lateral bars of pigment so characteristic of the later postlarval stages are completely absent. The large head, the long flat snout, and the tiny mouth are similar to the same structures in the older specimens. The number of body segments (35), together with the former characters, makes the identification of this peculiar fish easy even at such a small size. The notocord projects almost straight back from the body. The caudal rays are just beginning to form along its lower side. There is no trace of the dorsal, adipose, pectoral, ventral, or anal fins.

12-MILLIMETER STAGE (FIG. 60)

The specimen from station 953C is 12 mm in length without caudal. The head is contained in the length 3.7 times; the greatest depth of the body 6; and the snout to the insertion of the ventrals 2.3. The specimen is long and slender, quite unlike the adult in this character. The characteristic large head with the long flat snout and tiny mouth are present. The eyes at this stage point nearly vertically and are surrounded laterally by black pigment. There is a fine line of pigment extending backward along the ventral side of the head from each corner of the lower jaw. A similar, but median, line of pigment lies along the ventral midline below the heart and the anterior portion of the alimentary tract. The pigment along the dorsal and ventral

midlines of the posterior half of the fish, found in the smaller specimen, is not present on individuals of this length. There is a round, brownish blotch of pigment at the base of each of the ventral fins which extends above the middle of the body. A similar but lighter patch is found at the base of the caudal fin, covering two-thirds of the base. On each segment, except the first two anterior ones, there is a characteristic short bar of pigment below the lateral line. Posteriorly these bars fade and merge into each other. The similar bars found above the lateral line in the larger specimens are not found in fish of this size, although there is a slight indication of them. The pectoral fins are well formed; the rays are formed but are short and do not extend to the base of the ventrals. The ventral rays are also formed

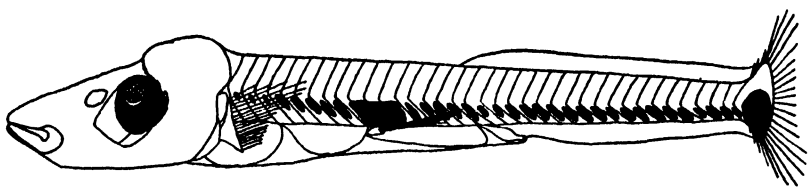


FIGURE 60.—*Macropinna microstoma*, new genus and species: Specimen 12 mm long, from station 9530.

but are likewise short and reach only to the anus. Most of the caudal rays are formed and the hypural plate is present. There is no indication of the dorsal, anal, or adipose fins, although there is a moderately large fin fold extending from the vent to the base of the caudal fin and another along the dorsal side from the caudal to above the insertion of the ventrals. The anus is inserted at about two-fifths of the way from the base of the ventrals to the caudal. The intestine extends from the third pigment bar ahead of the base of the ventral, where it emerges from the right side of the stomach, in a straight line to the sixth pigment bar behind the base of the ventrals. At this point the intestine becomes constricted and there is a dextral flexure. The intestine then widens out to form the rectum, and the anus lies below a vertical from between the ninth and tenth pigment bars behind the base of the ventrals.

16.5 MILLIMETER STAGE (FIG. 61)

The specimen from station 593B, 16.5 mm in length without caudal, has the typically slender body of the postlarval stages but differs somewhat from the 12 mm specimen. The body is somewhat deeper throughout than that of the latter. The head, snout, mouth, and eyes are the same. The lines of pigment extending back from the corners of the lower jaws are still present. The blotch of pigment at the base of the ventrals is constricted so that it lies over the abdominal cavity but does not extend up on the side of the body beyond the

insertion of the ventrals. The caudal pigment blotch extends completely across the base of the caudal fin. In addition to the segmentally arranged bars of pigment that are found below the lateral line on the smaller specimen there is a similar series above the lateral line that is prominent anteriorly but fades out before the origin of the dorsal. The rays of the pectoral are larger and extend beyond the base of the ventrals. The ventral rays are also much longer than those in the smaller specimen. They extend to the end of the anal fin. The dorsal and anal fins are both present, although their rays are not yet fully developed. The origin of the adipose fin can barely be made out in the median fin fold remaining between the dorsal and the caudal. The ventral median fin fold has disappeared. The large

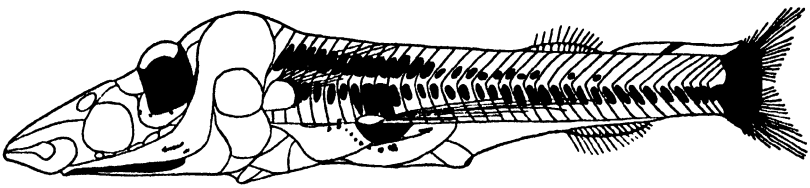


FIGURE 61.—*Macropinna microstoma*, new genus and species: Specimen 16.5 mm long, from station 293B.

rays of the caudal approach the form of the older specimens but the small rays dorsally and ventrally have not yet become differentiated. The intestine still originates from the right side of the stomach, but the pylorus has turned dorsally so that the intestine makes a half turn around the stomach. The posterior dextral flexure of the large intestine still lies under the sixth pigment bar behind the ventral base, but the small intestine has coiled back nearly to the level of the ventral origin. It has likewise lengthened. The anus has, in the meantime, moved forward until it lies under the eighth pigment bar behind the ventral origin and only a short distance posterior to the intestinal flexure.

Length without caudal 16.5 mm. Proportions in length without caudal: Length of head 2.8; greatest depth 5.1; snout to origin of the dorsal 1.4; snout to insertion of ventrals 2.1; snout to origin of anal 1.4. Proportions in the length of the head: Length of upper jaw, 4.0; diameter of eye 4.8; length of caudal peduncle 4.0; depth of caudal peduncle 3.4. There are 37 segments in the body.

25-MILLIMETER STAGE

The specimen from station 293B, 25 mm in length without caudal, has practically attained the adult form and characters but is important in that it still retains some of the larval characteristics. The segmentally arranged pigment bars below and above the lateral line, although faded, are still present. The peritoneum has become heavily

pigmented. Three small spots remain of the blotch of pigment that covered the base of the caudal in the smaller specimens. The body is otherwise without pigment. Although the digestive organs have become enlarged so that the depth of the body anteriorly approaches that of the adult form, the enlargements of the bases of the dorsal and anal fin remain transparent so that this fish appears to have the characteristic slender body of the smaller specimens. Whereas in the case of the 12 mm specimen the pectoral and ventral fins were well separated and the rays of the pectoral did not reach to the base of the ventrals, in this specimen the base of the ventrals lies only a short distance behind the bases of pectorals and the rays of the pectoral, when depressed, extend nearly to the base of the anal. The rays of the ventrals have become even more elongate and reach to the first rays of the caudal fin. Although the flexures of the intestine are obscured by the dense pigment of the peritoneum, it is apparent that the anus has moved farther anteriorly until it lies anteriorly to the posterior flexure of the intestine. It is considerably nearer a vertical from the base of the ventral than the origin of the anal. The scales have not yet formed.

Length without caudal 25 mm. Proportions of the length without caudal: Length of head 2.3; snout to origin of dorsal 1.3; snout to the adipose 1.0; snout to insertion of the pelvics 1.7; snout to the origin of the anal 1.3; greatest depth 3.4. Proportions of the length of the head: Diameter of eye 3.1; length of upper jaw 3.7; depth of caudal peduncle 3.7; length of caudal peduncle 3.1. There are 37 segments in the body.

Remarks.—Several characters are remarkably changed during the development of this species. The intestine coils and the anus moves anteriorly nearer to the level of the origin of the ventrals. The bases of the ventrals move forward nearer to the bases of the pectoral. The growth downward of the abdominal cavity also makes the bases of the ventrals appear to move higher on the body. The depth of the body and the bulk of the head increase so considerably that the general shape of the adult fish little resembles that of the long slim postlarvae. The rays of the pectoral and the ventral, especially the latter, become greatly elongate. The adipose is the last of the fins to appear.

This peculiar species of fish appears to be somewhat related to the species of the genus *Opisthoproctus* of the family Opisthoproctidae, which are found in the eastern Atlantic (Vaillant, 1888; Zugmayer, 1911a and 1911b; and Roule and Angel, 1933); the western Atlantic (Gregory, 1933); and the western Pacific in the South China Sea (Trewavas, 1933). No fish remotely resembling the present species has been described from the eastern Pacific. From the species of *Opisthoproctus* this species differs strikingly in the presence of a

maxillary (absent in *Opisthoproctus*), which is broadly expanded posteriorly; by the perfectly normal anal fin, which is larger than the dorsal, and the normally placed anus (in *Opisthoproctus* the anus opens posteriorly near the base of the caudal fin; the anal fin is normally atrophied and is either very small and only slightly separated from the caudal, or is so closely appressed to the latter that it appears to be absent); by the differences in the size and shape of the opercle and subopercle (*Opisthoproctus* has the opercle long and narrow; the subopercle is very small and is almost hidden by the preopercle); by the lack of a ventral sole (this peculiar structure, characteristic of *Opisthoproctus*, consists of a flattened ventral surface which projects more or less beyond the normal outline under the head and is supported by the anterior arms of the cleithra); by the position and extreme length of the ventral and pectoral fins (in *Opisthoproctus* the ventral fins project into the ventral outline and are of normal length); and by numerous other peculiarities (see Trewavas, 1933). The new genus and species resembles *Opisthoproctus* in the small gape, the general shape of the body, the presence of an adipose fin, and the dorsally directed eyes.

Named in reference to the elongate pectoral and ventral fins and the tiny mouth.

Family MELANOSTOMIATIDAE

PHOTONECTOPS, new genus

Genotype.—Photonectops multipunctata, new species.

Stomiatoid fishes having the general characters of the Melanostomiatidae as defined by Parr (1927). Vertical fins confined to the tail; dorsal and anal fins beginning at the same vertical and covered with only normal fin membrane. Pectoral fins absent. Pelvic fins close together and inserted well behind the middle of the body. Vertebrae 82 as counted by Dr. Schultz and Mr. Reid of the National Museum from an X-ray of the type made through the courtesy of officials of the U. S. Naval Hospital.

Mouth noticeably curved upward so that the symphysis of the lower jaw projects beyond the snout when the mouth is closed. Teeth in lower jaw very numerous with some fanglike; arranged in many oblique rows. Teeth on maxillary also arranged in several rows. Premaxillary teeth stout and recurved, not depressible. Two rows of large depressible fangs on the "tongue." Teeth present on the palatines but not on the vomer.

Snout rather reduced; not protractile or movable. Normal membranous floor between lower jaws. Lateral photophores well developed and very numerous. A large suborbital organ posteriorly; a smaller anteroventral luminescent organ on the border of the eye; and a similar small organ on the anterodorsal margin of the eye.

Photonectops is probably most closely related to *Photonectes* from which it is differentiated by the more numerous photophores in the lateral series, the more numerous teeth, which are arranged in several rows, by the absence of pectoral fins (present in some species of *Photonectes*), and by more than one suborbital organ on each side of head. From *Melanostomias* and *Echiostoma* it is differentiated by the more numerous teeth, the more numerous photophores, the elongate slender shape, and the cleft of the mouth being long and strongly curved upward anteriorly. From *Echiostoma* it differs further in having no pectoral fins. From *Lamprotoxus*, *Grammatostomias*, and *Opostomias* it differs by the more posterior insertion of the ventrals. From *Eustomias* and *Flagellostomias* it is distinguished by the anal and dorsal fins beginning at the same vertical. From *Photostomias* and *Malacosteus* it is separated by the presence of a barbel and the presence of a normal floor between the lower jaws. From *Pachystomias* it is told by the presence of teeth on the maxillaries and the normal floor between the lower jaws. From *Aristostomias* it is differentiated by the normal floor between the lower jaws, the strongly curved jaws, and lack of pectorals.

Other characters of the genus are those of the species.

PHOTONECTOPS MULTIPUNCTATA, new species

FIGURE 62

Types.—Holotype, a specimen 280 mm in standard length from station 1256C taken January 3, 1935, latitude 51°15′ N., longitude 131°37′ W., U.S.N.M. no. 108144, and one paratype from station 665C, April 14, 1932, latitude 51°16′ N., longitude 130°35′ W., U.S.N.M. no. 108160.

Description.—The species is described from two specimens. The holotype is in good condition except for the loss of some skin on the dorsal surface, the sides, and the caudal region and fraying of the fins. The barbel is reduced to a short black stub. It is not possible to determine whether this is the natural state or whether the organ has been broken off. Except for the broken tips of the fin rays the smaller paratype (from station 665C) also is in excellent condition.

The proportions and counts for the holotype are: Dorsal rays 16; anal rays 19; pelvic fins 10 rays on the left side and 9 on the right. Length without caudal 280 mm. Proportions of the length without caudal: Snout to insertion of the ventrals 1.5; snout to insertion of anal 1.1; greatest depth (before ventrals) 14.8; depth behind head 21.5; diameter of eye 56.0; length of lower jaw 11.7; length of snout 46.6; length of longest ventral ray 7.6. The large, nearly circular, luminous spot behind and below the eye is covered by dark pigment; the smaller one on the anteroventral border of the eye, noted in the

smaller specimen, is here reduced to a small spot. Above the latter, on the anterodorsal margin of the eye, is a third small luminescent spot of crescentic shape. Scattered over the body and head are a myriad of small glandular bodies. Between each pair of branchiostegal rays is a photophore of the same type as those in the lateral and ventral rows. The two rows of photophores along the lower half of the body, typical of the fishes of this relationship, are present here. In the lateral series there are 46 photophores between the operculum and the base of the ventral fin (O–V) and 20 between the base of the ventral and the beginning of the caudal series (V–A). In the ventral series there are 57 photophores between the isthmus and the base of the

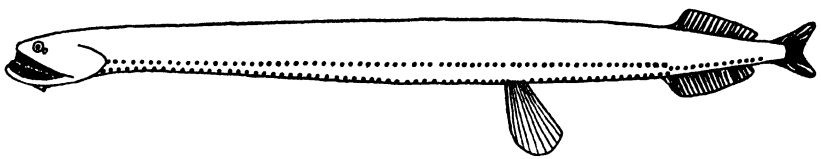


FIGURE 62.—*Photonectops multipunctata*, new genus and species: Holotype (U.S.N.M. no. 108144), 280 mm long, from station 1256C.

ventral (I–VO) and 21 between the base of the ventral and the beginning of the caudal series (V–A).

Because of loss of skin, the caudal series can not be counted accurately on the large specimen.

In the lower jaw there are about 85 teeth varying in size from minute denticles to moderate-sized fangs. Near the symphysis there are 2 teeth, behind these a group of 3 teeth, and posterior to this there is a patch of 4 teeth. Posterior to this last group, and separated from it by a short interspace, the remaining teeth are arranged in 11 oblique, parallel rows, which have 5 to 7 teeth in each. The teeth on the anteroexternal end of the rows are minute denticles. The others graduate in size to the large fangs on the posterointerior end of the row. The teeth in the rows become smaller toward the corner of the jaw. In the upper jaw there are 21 teeth of assorted sizes. Eight of these are on the palatine, 4 on the premaxillary, and the remaining 9 are arranged in 3 oblique rows on the maxillary. There are no teeth on the vomer. The teeth on the two palatines are separated by a median bare space anteriorly. The 4 teeth on the premaxillary are stout and recurved, differing from all the other large teeth in the mouth by not being depressible. They are up on the side of the jaw and do not enter into the gape. There are two rows of large depressible fangs on the "tongue," each consisting of 6 teeth. The first three pairs are based on the glossohyal and are separated by a small interspace from the last three pairs, which are apparently borne by the first basibranchial. The mouth is noticeably curved upward,

and the heavy symphysis of the lower jaws projects beyond the snout when the mouth is closed.

The eye is large, being only a little less in diameter than the length of the snout. The interorbital space is wide and convex. The lower jaws are connected by a full membrane, which is attached to the tip of the isthmus. There are 13 branchiostegal rays. The barbel is a little nearer the isthmus than the symphysis. It is a short, stout, jet-black stub, which, as mentioned above, may be natural or may be only the remainder of a mutilated organ. As it is, it does not show in the ventral outline but is entirely contained in the concavity between the two jaws.

The body is jet-black over all. Much of the thin epidermis was rubbed off in removing the fish from the net, although great care was taken to avoid such mutilation. This exposed a lead-gray dermis. The form of the body is elongate and terete. It is most compressed and deepest ahead of the insertion of the ventrals. There are no pectoral fins. The pelvic fins are inserted well behind the middle of the body and near the ventral outline. The base is broad; the rays are stout. Although many of the rays have been broken off, the four which are intact are long (7.6 in length without caudal) and taper to fine filaments. The anal and dorsal originate on the same vertical and are both covered only by a normal membrane. The caudal is small and deeply notched.

The much smaller paratype differs in some respects from the above description. It has 14 dorsal rays, 19 anal rays, and the ventral on both sides contains only 8 rays. The caudal has 25 rays, 3 short fine rays above, 4 long thick rays forming the upper lobe of the fin, 11 shorter, much more delicate rays forming the fork of the tail, 4 more long stout rays forming the lower lobe, followed by 3 rays on the ventral side of the fin similar to those on the dorsal side. The length without caudal is 99 mm. Proportions of the length without caudal: Snout to ventrals 1.5; snout to anal 1.2; depth ahead of ventral insertion 19.8; depth behind head 22.0; diameter of eye 33.0; length of the lower jaw 9.2; length of snout 38.2; the longest ventral ray 14.1.

The anterior two-thirds of the circular postorbital luminous spot shows as a typical white patch; the posterior one-third is covered by pigment. The spot on the anteroventral margin of the eye is more distinct than that in the holotype. There is no luminous spot on the anterior dorsal margin of the eye. Owing to the lighter color of the epidermis the myriad tiny glandular dots over the body and head are more apparent than they are on the larger specimen. They each consist of a white dot surrounded by black pigment. They are not arranged in any definite pattern except upon the lower jaw, where there is a straight, closely crowded row extending back along the

ventral surface from the symphysis, and around the eye, where a row completely encircles that organ. In the lateral series there are 45 photophores in the O-V series and 18 in the V-A series. In the ventral row there are 57 organs in the I-V series and 19 in the V-A series. In the caudal series there are 13 photophores. There are 14 photophores in the branchiostegal series, and 13 branchiostegal rays.

The body is slenderer than that of the larger specimen. It is black along the abdominal region, but not densely jet-black as in the holotype. The rest of the body and the head are a rich brown. The barbel is 4 mm long, and is completely contained in the depression between the lower jaws. Its base is stout and it tapers to a fine point. It is rather simple, devoid of luminous bulbs or tendrils, and does not appear to have been broken.

There are only 45 teeth on the lower jaw. These are arranged similarly to those in the holotype except that there are only 9 oblique rows posteriorly and each of these rows contains only 4 or 5 teeth. On the upper jaw there are about 30 teeth arranged like those on the larger specimen. The rows on the "tongue" have 7 teeth in each, the additional pair being inserted upon the basihyals.

Remarks.—Both of these specimens were taken off the west coast of British Columbia. The depth of their capture indicates that they are probably similar to the other Gymnophotodermi in being confined to a truly bathypelagic habitat.

Named in reference to the numerous photophores in the lateral and ventral series.

Order INIOMI

Family SUDIDAE

Genus SUDIS Rafinesque, 1810

SUDIS SQUAMOSA, new species

FIGURE 63

Holotype.—A specimen 85 mm without caudal, from station 734B, taken May 10, 1932, latitude 56°55′ N., longitude 156°11′ W., U.S.N.M. no. 108150, is clearly referable to the genus *Sudis* but differs from any other species described in that genus.

Description.—Dorsal rays 12; anal rays 21; caudal rays 41; pectoral rays 20; ventral rays 10; branchiostegal rays 9; gill rakers 9+30 on the first arch. Proportions of length without caudal: Length of head 3.9; snout to dorsal 1.8; snout to adipose 1.2; snout to pelvics 1.8; snout to anal 1.4; greatest depth 7.7; diameter of eye 14.2; length of snout 12.1; length of upper jaw 8.5; interorbital space 21.2; depth of caudal peduncle 17.0; length of caudal peduncle 12.1; length of pectorals 8.5; length of ventrals 7.7; length of dorsal base

7.7; length of anal base 6.1; dorsal origin to base of middle rays of caudal 2.3; anal origin to base of caudal 3.9; length of adipose fin base 10.6.

The body is covered everywhere with minute scales that can scarcely be made out without the help of a lens. The head is naked and bears no pronounced ridges. The snout is conical and pointed, only slightly longer than the diameter of the large round eye. The premaxillary reaches to a vertical from the middle of the eye and excludes the maxillary from the upper jaw. The lower jaw projects slightly. The premaxillary is completely toothed along its lower edge with a single row of small, conical teeth. The dentary is similarly toothed on its anterior two-thirds. The symphyseal knob is toothed and projects into a toothless cavity at the junction of the premaxillaries when the mouth is closed. The vomer has a single row of minute conical teeth on the anterior edge of the head of the bone; there are no teeth on the shank. The palatines have an irregular row of minute teeth along nearly the whole length of each bone, which is double on the anterior half of the bone and single posteriorly. The entire dorsal surface is covered with small, widely spaced teeth. The gill membranes are not united and are not attached to the isthmus. The gill rakers are long and slender.

The dorsal fin is high and short and is inserted nearer to the tail than to the snout. The adipose fin originates over the middle of the anal. Its base is long; the fin is low and fimbriated. Neither the tip of the adipose nor the rays of the anal, when depressed, reach to the rudimentary rays of the caudal. The pectoral fins are inserted very low, with the bases oblique and quite broad. The fin is the same length as the upper jaw. The pelvic fins originate under the second dorsal ray. Their rays are heavier and thicker than those of the pectorals, and the fins are slightly longer than the latter. The anal fin is long and moderately low and is inserted far back on the body so that the distance from the anal origin to the base of the middle rays of the caudal is the same length as the head, or 3.9 in the length without caudal. The caudal fin is forked, with rudimentary rays dorsally and ventrally, short weak rays in its middle and longer, stout rays forming the dorsal and ventral lobes. The anus opens directly before the anal fin.

Remarks.—Two other species of this genus, *Sudis ringens* and *S. coruscans*, have been described from the west coast of the United States by Jordan and Gilbert (1881a and 1881b), the former from southern California and the latter from the Straits of Juan de Fuca. From both of these the present species can be easily distinguished. In *Sudis squamosa* the greatest depth is contained in the length without caudal 7.8, the length of the head 3.9, the snout to anal 1.3; the upper jaw is contained in the head 2.2, the length of the caudal peduncle 3.1;

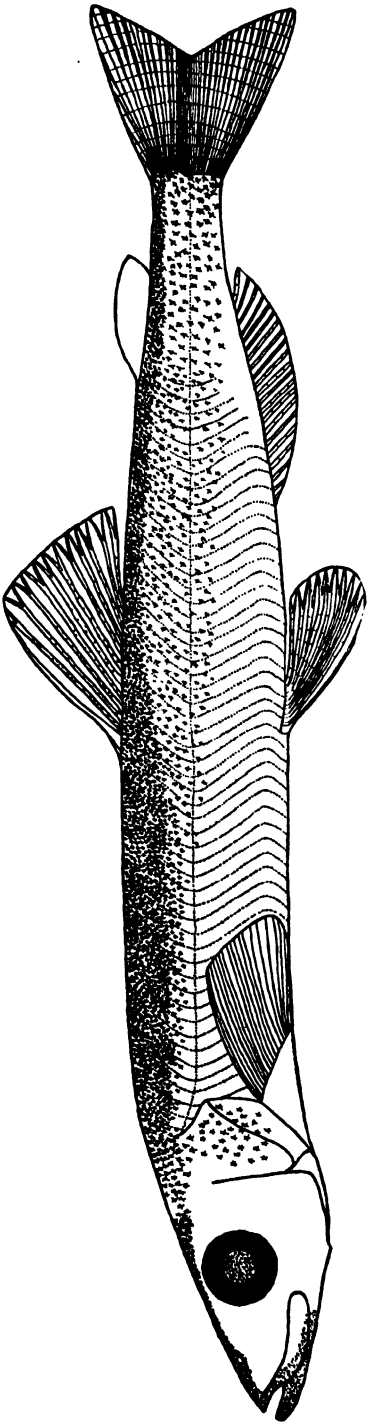


FIGURE 63.—*Sudis squamosa*, new species: Holotype (U.S.N.M. no. 108150), 85 mm long, from station 734B.

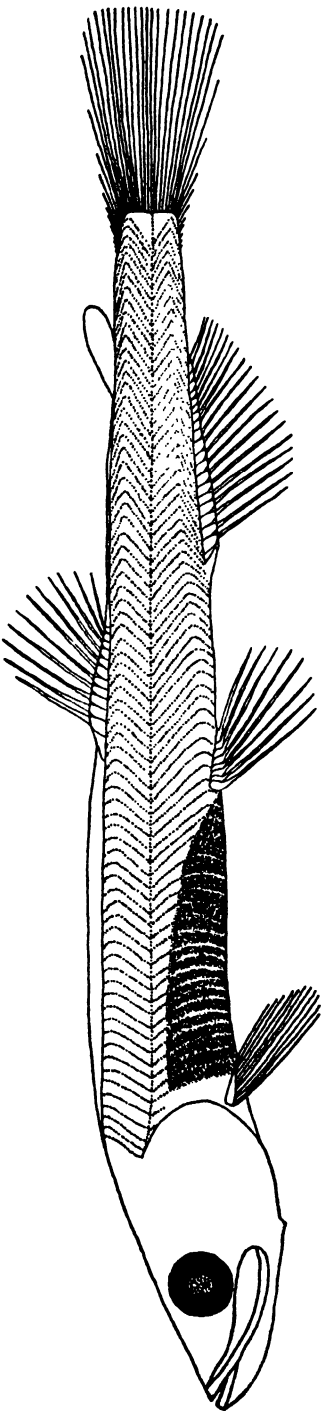


FIGURE 64.—*Lestidium* (*Bathysudis*) *parri*, new species: Holotype (U.S.N.M. no. 108140), 57 mm long, from station 118B.

there are no canine or fanglike teeth on the tongue, dentaries, or palatines, the gill rakers are long and slender; the vent is in its normal position before the anal fin, far behind the bases of the pelvics; there are 12 rays in the dorsal, 21 in the anal, and 20 in the pectorals; the scales are very minute; and the ventrals are inserted under the second ray of the dorsal. *Sudis ringens* (according to Jordan and Gilbert, 1881a, p. 273) has the depth contained in the length 16.0 times, the head 6.1 times, and the snout to the anal 1.25 times; the upper jaw is contained in the head less than 2 times, the length of the caudal peduncle 2.7 times; there are canine teeth on the dentaries and palatines; there are no teeth on the tongue; the gill rakers are short, sharp, spinelike; there are 11 rays in the dorsal, 26 in the anal; the scales are very large. In *Sudis coruscans* (Jordan and Gilbert, 1881b, pp. 411–412) the depth is contained in the length 13 times; teeth not fanglike; the gill rakers are broader than they are long; the vent is slightly behind the base of the ventral fins; dorsal rays 8, anal rays 31; pectoral rays 9; scales small with those of the lateral line large, nonimbricated and platelike; the ventrals are inserted completely behind the base of the dorsal. These differences, among many others, show the present species to be widely different from these two. It appears to be more similar to *Lestidium* (*Bathysudis*) *speciosum*, from which, however, it can be told by the presence of scales, the more anterior insertion of the ventral, and other characters (according to the description and figure of Parr, 1928, pp. 42–43 and fig. 4) *Sudis ringens* has been synonymized with *Sudis rissoi kroyeri* by Parr (1928).

Named in reference to the squamation.

Genus LESTIDIUM Gilbert, 1905

LESTIDIUM (BATHYSUDIS) PARRI, new species

FIGURE 64

Types.—Holotype, a specimen 57 mm in length without caudal, from station 118B, taken February 12, 1929, latitude 59°45′ N., longitude 147°00′ W., U.S.N.M. no. 108140, and 3 paratypes from station 120, taken February 13, 1929, latitude 59°49′ N., longitude 144°50′ W., in the IFC collection.

Description.—(In this paragraph the measurements and counts are given for the holotype followed by the range of the paratypes in parentheses.) Dorsal ray 11 (11 to 13); anal rays 20 (20 to 22); caudal rays 43 (41 to 45); pectoral rays 11 (11); pelvic rays 8 (8); gill rakers on first arch 5+18 (5+17 to 5+18). Proportions of length without caudal: Length of head 4.0 (3.8 to 3.9); snout to dorsal 1.8 (1.8); snout to adipose 1.2 (1.2); snout to pelvic 2.0 (1.8 to 2.0); snout to anal 1.4 (1.4); greatest depth 8.1 (7.1 to 7.2); diameter of eye 19.0 (14.3 to 18.0); length of snout 14.2 (14.3 to 16.7); length of

upper jaw 8.1 (7.1 to 7.2); interorbital space 16.3 (15.4 to 16.7); depth of caudal peduncle 16.3 (15.4 to 16.7); length of caudal peduncle 8.1 (8.3 to 9.0); length of pectorals 8.1 (8.3 to 9.0); length of pelvics 8.1 (8.3 to 9.0); length of dorsal base 9.5 (9.0 to 9.1); length of anal base 5.7 (5.4 to 5.6).

The body and head are moderately compressed, the latter deeper than wide. There are no scales on the bodies of any of the specimens. All the fish, however, are obviously juveniles and the scales have perhaps not yet developed. There is a lateral line present. The length of the snout is the same or only slightly greater than the diameter of the eye. The eyes are moderately large and are placed laterally. The interorbital space is broad and is only slightly convex. The nostrils lie midway between the tip of the snout and the eyes. The premaxillary extends to or beyond a vertical from the posterior margin of the eye.

The lower jaw projects, the symphyseal knob is slightly elevated, toothed, and fits into a toothless concavity at the junction of the premaxillaries. There is a single row of relatively large, recurved teeth on the premaxillaries that becomes smaller posteriorly. The teeth hook over the outside of the dentaries when the mouth is closed. The teeth on the dentaries form an irregular single series, some of the anterior of which project out slightly to meet those of the premaxillaries. The vomer bears a line of 4 or 5 large teeth on the head and one on the shank. The palatines have an irregular series of teeth running nearly the length of the bone; some of these are considerably larger than the others. The tongue is free anteriorly and bears 5 or 6 large canine teeth upon its dorsal surface. The largest of these is in a median position anteriorly. Behind it there is a row of either 2 or 3 similar teeth on each side that are spaced rather widely. Extending posteriorly along the basihyals and basibranchials is a double row in which the teeth are smaller and more closely set than those on the tongue. The maxillaries are large and long, extending along three-quarters or more of the length of the premaxillaries. The gill rakers are long and slender. The pseudobranchiae are well developed.

The dorsal fin is high and short. The adipose is inserted above the posterior third of the anal. It is moderately high and has a distinct lobe projecting freely behind. The pectoral fins are small and have weak rays. They are placed very low on the body, nearly in the ventral outline. The pelvics are likewise placed low, a little behind the middle of the body, yet in front of the origin of the dorsal. Their rays are stouter than those of the pectorals. The anal originates well behind the dorsal and contains nearly twice as many rays as the latter. The tail, measured from the origin of the anal to the base of the middle rays of the caudal, is less than one-third the length of the body.

The dorsal third of the body is liberally sprinkled with brown punctulations. The base of the anal bears 4 or 5 larger pigment spots. There are a few pigment spots on the caudal peduncle. A ring of small pigment spots nearly encircles the eyes, and the snout and anterior dorsal surface of the head likewise bear chromatophores. At the symphysis of the dentaries there are a few spots which extend nearly half the distance down each dentary. The rest of the body is without dark pigment except along the ventral midline between the pectoral and pelvic fins where the body musculature is not complete and the blue-black peritoneum is exposed.

Remarks.—This species is most closely related to *Lestidium* (*Bathysudis*) *speciosum*. It differs from that species by the presence of teeth on the vomer, the characteristic dentition of the tongue and pharynx, and the fact that the upper jaw extends to or beyond a vertical from the posterior edge of the eye.

The subgenus *Bathysudis*, which Parr (1928) has introduced for *L. speciosum* and to which the present species clearly belongs, should probably be recognized as a separate genus. The comparatively short and rounded body, the short conical snout, and the wide gape extending to or beyond the anterior edge of the eye mark these two species from the rest of the genus *Lestidium*, for the tendency in that genus is toward a long snout with the maxillary not reaching to the eye and toward a long slender body with a comparatively short tail.

All the specimens were taken in moderately shallow water, the deepest net having only 170 meters of wire out. Both stations were taken in the northern part of the Gulf of Alaska, station 118B near the mouth of Prince Williams Sound, and station 120 near Cape St. Elias.

Named for Dr. A. E. Parr, in honor of his extensive work with deep-sea fishes.

Family MYCTOPHIDAE

Genus MYCTOPHUM Rafinesque, 1810

MYCTOPHUM OCULEUM, new species

FIGURE 65

Types.—Holotype, a specimen 42 mm without caudal, from station 533D.T., taken July 3, 1931, latitude 54° 15′ N., longitude 158° 23′ W., U.S.N.M. No. 108146, and 37 paratypes from the following stations: 11B; 25B; 34B; 106B; 167C; 171C; 172B; 184A; 189A; 209B; 256A; 256C; 266B; 282C; 284C; 306B; 307B; 317B; 322C; 333C; 340B; 344B; 350; 365; 373; 382; 386?; 389C; 426C; 451D.T.; 452B; 453D.T.; 528D.T.

The paratypes in the United States National Museum bear the numbers 108158 and 108159.

Description.—(The measurements and counts of the holotype are given followed by the range and average of the paratypes in parentheses.) Dorsal rays 13 (11 to 13; 11.7); anal rays 25 (22 to 25; 23.5); pectoral rays 16 (15 to 16; 15.1); pelvic rays 8 (8); scales in lateral line 38 (35 to 39; 36.9); number of AO 17 (15 to 18; 16.0). Proportions of the length without caudal: Length of head 2.9 (2.6 to 3.1; 2.90); snout to dorsal 2.1 (1.7 to 2.1; 1.93); snout to adipose 1.3 (1.2 to 1.4; 1.29); snout to pelvics 2.4 (2.0 to 2.4; 2.25); snout to anal 1.7 (1.6 to 1.9; 1.75); greatest depth 3.5 (3.0 to 3.9; 3.38). Proportions of the length of head: Diameter of eye 2.5 (2.0 to 2.8; 2.35); length of upper jaw 1.5 (1.2 to 1.6; 1.40); length of caudal peduncle 2.5 (1.8 to 3.4;

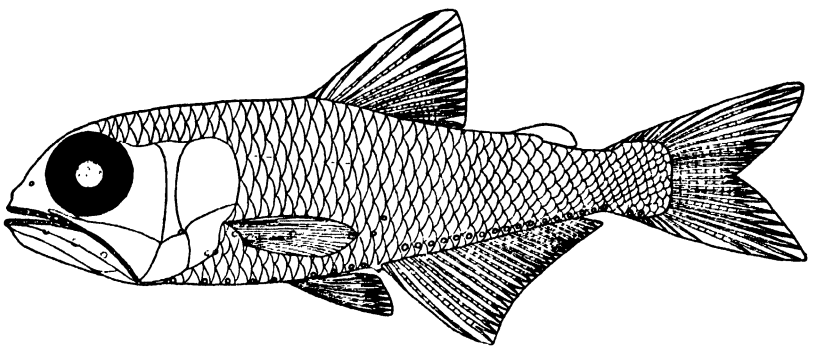


FIGURE 65.—*Myctophum oculeum*, new species: Holotype (U.S.N.M. no. 108146), 42 mm long, from station 533D.T.

2.49); depths of caudal peduncle 3.8 (2.7 to 4.0; 3.45); length of pectoral fins 1.9 (1.4 to 2.0; 1.69); length of pelvic fins 2.1 (1.5 to 2.1; 1.96).

The body is compressed, short, and deep. The scales are cycloid and caducous. Those of the lateral line are greatly broadened. The eyes are large but normal; the lenses are only slightly elliptical and are not noticeably turned upward. The anterior profile is more rounded than common in the genus. The premaxillaries have each a band of small villiform teeth along the entire edge, even on the lateral portion of the bone. The dentaries are toothed in a similar fashion. The vomer has a small round patch of teeth at each of the two anterolateral corners of the head of the bone, but none between or on the shank. The palatine has a small patch of teeth lying closely behind the patches on the head of the vomer, a short bare space, and then a small band of teeth extending ventroposteriorly to the end of the bone. The maxillary is expanded posteriorly, forming a broad triangle; the square-cut posterior edge reaches beyond a perpendicular from the posterior margin of the eye. The gill rakers are long and slender and bear a row of toothlike processes on the inner edge of each.

The dorsal is short and high, its longest ray (the fourth) reaches past the end of the fin base to the origin of the adipose. The adipose lies over the posterior fourth of the anal fin; its free portion is slightly longer than its base. The pectorals are inserted moderately high on the body and are good sized. Their rays reach beyond the anterior SAO and nearly to the insertion of the anus. The pelvics are inserted on the ventral contour of the body a little nearer the insertion of the pectorals than the origin of the anal. Their longest rays extend past the anus to the third or fourth ray of the anal fin. The anal is long and moderately high, its longest ray (the third) when depressed reaches two-thirds of the length of the base of the fin; it originates under the posterior third of the dorsal.

There are the usual three photophores on the under jaw, the small one at the end of the premaxillary, and the larger one directly above on the angle of the preopercle. The PLO is well below the base of the pectoral fin, on a level with the most anterior and ventral of the two PVO and is nearly hidden by the edge of the subopercle. The ventral PVO lies a third of the way along a straight line from the dorsal PVO to the most anterior of the PO series. There are 5 PO, all of which are on the same level; but the last three are closer together than the first two. The VLO is about midway between, and forms a straight line with the dorsal PVO and the most anterior SAO. There are 4 VO all on the same level. The middle one of the 3 SAO is about one-third of the distance from the posterior one and lowered enough so that the three form a wide anteriorly facing angle. The AO are in a single series that is well separated from the PRC. All the photophores are on the same level. There are 2 PRC; the posterior one is slightly more dorsal than the anterior one. Luminescent scales are found above or below the caudal peduncle on the larger specimens, but not in both places on the same specimen. There are no antorbital or suborbital luminescent organs; no photophores above the lateral line; and no POL.

Remarks.—Myctophum oculeum is most closely related to that group of species of the genus that have no photophores above the lateral line, no POL, with the AO in one single continuous series, and with the PLO at or below the base of the pectoral fin. This group consists of *M. parallelum*, *M. arcticum*, *M. rissoi*, *M. anderssoni*, *M. antarcticum*, and *M. subasperum*. In the following sentences, the characters given for these species are taken from Parr (1928) unless otherwise noted. From *M. parallelum* this species is differentiated by the first two SAO and the two PRC not being separated by conspicuously wider interspaces as in the former; the head is included 2.6 to 3.1 in the length without caudal instead of 4.0; the AO are generally less than 18 (in only one specimen out of 38 are there 18 AO) while in *M. parallelum* the AO are 18; the eyes are not telescopic, and the lens

is never more than slightly excentric. *M. oculeum* is separated from *M. arcticum* by its eyes being normal and the lens not being markedly excentric; by having the dorsal rays 11 to 13 instead of 9 as in the latter (according to Goode and Bean, 1895); and by having 22 to 25 anal rays instead of 17 (op. cit.). This species differs from *M. rissoi* by having the eye 2 or more in the head instead of 2 or less; by having the PLO on a level with the lower PVO instead of above the dorsal one as shown by Goode and Bean, 1895, for the latter; and by having 15 to 16 AO instead of 11 (op. cit.). From *M. anderssoni*, *M. oculeum* can be told by the longer head (2.6 to 3.1 in *M. oculeum*, 3½ in *M. anderssoni*); and by the two anterior AO not being elevated as in *M. anderssoni*. *M. oculeum* is distinguished from *M. antarcticum* as described by Goode and Bean, 1895 (under the name of *Myctophum colletti*), by having 11 or 12 dorsal rays instead of 15; by having more than 21 anal rays, and 15 instead of 13 pectoral rays. *M. subasperum* has the origin of the anal at the vertical from the end of the base of the dorsal fin and has ctenoid scales, whereas *M. oculeum* has the anal originating under the posterior third of the dorsal fin and has cycloid scales. Furthermore, *M. parallelum*, *M. arcticum*, *M. rissoi*, and *M. anderssoni* have never been taken in the Pacific, according to Parr (1928). *M. antarcticum* is found only in Antarctic waters. Although *M. subasperum* has been taken in the Pacific, it has never been taken in the northeastern section of that ocean. *M. oculeum* represents the first record of a species of this interesting group from the Pacific coast of North America.

The present range of *M. oculeum* extends from off the coast of Washington through British Columbia waters and the Gulf of Alaska to off Kodiak Island. It has been taken only in waters outside the 100-fathom line.

Named in reference to the large and peculiar eyes.

Genus LAMPANYCTUS Bonaparte, 1840

LAMPANYCTUS MICROPUNCTATUS, new species

FIGURE 66

Types.—Holotype, a specimen 77 mm in length without caudal, from station 622C, taken March 28, 1932, latitude 53°40′ N., longitude 134°15′ N., U.S.N.M. no. 108142, and 19 paratypes from the following stations: 167A; 183C; 189B; 319A; 338B; 621C; 633C; 699C; 752A; 765B; 976C; 1014B; 1020B; 1110C; 1118C; 1120C; 1143A.

Those paratypes in the United States National Museum bear the numbers 108161–108167.

One of the two specimens from station 338B was too desiccated to use in the measurements.

Description.—(In this paragraph the proportions and counts of the holotype are outside the parentheses and those of the paratypes in the parentheses.) Dorsal rays 15 (14 to 16); anal rays 18 (17 to 19); caudal rays 36 (33 to 38); pectoral rays 15 (14 to 15); pelvic rays 8 (8); scales in a lateral series 36 (36 to 39); AO 7+8 (6 to 8+7 to 8); supracaudal luminous scales 4 (3 to 5). Infracaudal luminous scales 7 (5 to 8). Proportions of the length without caudal: Length of the head 3.7 (1.3 to 3.8); snout to dorsal 2.1 (1.9 to 2.1); snout to adipose 1.3 (1.3 to 1.4); snout to ventrals 2.5 (2.1 to 2.5); snout to anal 1.8 (1.7 to 1.9); greatest depth 5.4 (5.0 to 5.9); length of caudal peduncle 4.7 (4.0 to 5.0). Proportions of the length of head: Diameter of eye

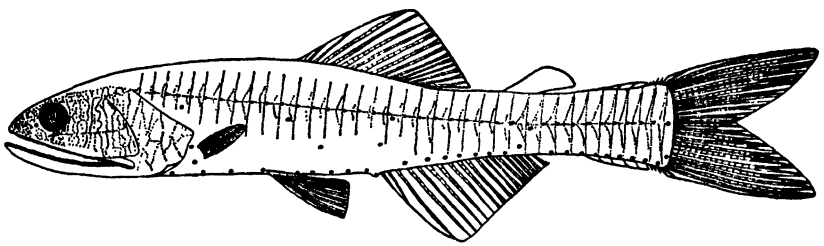


FIGURE 66.—*Lampanyctus micropunctatus*, new species: Paratype, 85 mm long, from station 1830.

5.4 (5.4 to 6.5); length of snout 4.7 (3.4 to 5.4); length of upper jaw 1.4 (1.1 to 1.4); depth of caudal peduncle 2.8 (2.7 to 3.8).

The adipose fin is inserted over the last four rays of the anal. The pectorals are inserted below the angle of the opercle. The base is narrow; the rays are fine and filamentous, the middle ones reaching beyond the bases of the ventrals. The ventrals are placed well ahead of the origin of the dorsal. The anal originates under the third or fourth from the last dorsal ray.

All the photophores on the head and body are very small, those on the head being especially degenerate. The antorbital is marked only by a small bit of black pigment on the anterior edge of the orbit on a level with the center of the eye. The customary row of photophores under the mandible is only faintly visible through the covering skin. The photophore at the angle of the jaw is a tiny dot; the one on the operculum directly above it, and a little above a horizontal line through the upper pectoral rays, is larger but is only faintly seen through the skin. There are no photophores on the cheek or on the shoulder. The PLO is high, situated about one-fourth the distance from the lateral line to the base of the pectoral, and only a little posterior to a line through the PVO and the second PO. The upper PVO is level with the dorsal pectoral rays; the second lies halfway from the upper PVO on a line from that organ to the second PO. There are four PO, all lying on the same level. The first lies under the edge of the branchios-

tegal membrane and is farther from the second than the second is from the third; the second, third, and fourth are separated by approximately equal interspaces. The VLO is about the same distance from the lateral line to the base of the ventrals. There are four or five VO, all on the same level and separated by nearly equal intervals. The SAO form an angle of about 100°. The upper one is separated from the lateral line by a distance only slightly greater than its small diameter; the second is halfway along a straight line between the upper SAO and the most posterior VO; the third is far forward, nearer to a perpendicular through the second VO than one through the third, and it is slightly below the level of the second SAO. The AO are in two distinct series 6–8 + 7–8. Where the PRC are confluent with the posterior series of AO they have been counted as four, in accordance with the method of Parr (1928, p. 77). The remainder of the series has been counted as AO posteriores. The first AO anterior is a little below the level of the rest of the series; the others are all on the same level. There are two POL the dorsal one touching the lateral line and lying over the interspace between the two series of AO; the ventral one in on a line between the dorsal POL and the last photophore of the anterior AO series, nearer to the latter than to the former. There are four PRC. The ventral three are close together and lie in a gentle arc curving upward from the level of the AO. The dorsal PRC is separated from the ventral three by a wide interspace and lies directly on the end of the lateral line. The PRC are usually separated from the AO posteriores but in some specimens on one or both sides the two series are confluent. There are luminescent scales both supra- and infra-caudally on all specimens. The supracaudal series (3 to 5 scales) is always shorter than the infracaudal series (5 to 8 scales). While these luminescent scales are not so well defined as in the species of *Myctophum*, their boundaries can be made out in each case. There are no other such luminescent scales on any other part of the body or head. There are no photophores above the lateral line.

Remarks.—Lampanyctus micropunctatus does not appear to be especially close to any other species in the genus. If the phrase "PRC distinctly separate from AO" be eliminated from A, I in Parr's key (Parr, 1928, p. 78) this species will fit into the group containing *L. nicholsi*, *L. braueri*, *L. maderensis*, *L. townsendi*, and *L. warmingi*. It should be included under a separate division C, under A, I. This division C should read "Only four PRC. Four PO." The character "four PO" will serve to separate this species from those listed in the group above.

Lampanyctus micropunctatus has been taken off Queen Charlotte Sound, off the west coast of the Queen Charlotte Islands, off Prince of Wales Island, off Portlock Bank, and off Albatross Bank. "Off" is necessary in the above phrases because it has been on each occasion

taken outside the 100-fathom line. No specimens have been taken at the stations between the one near Prince of Wales Island and the one near Portlock Bank.

Named in reference to the tiny photophores.

Family SCOPELARCHIDAE

NEOSCOPELARCHOIDES, new genus

Genotype.—*Neoscopelarchoides dentatus*, new species.

The characters of the genus are those of the species.

This genus is most closely related to the genera *Scopelarchus* and *Scopelarchoides*. It differs from both in the proportionately slender and longer body, in the lack of differentiation of the teeth on the glossohyal, in the much longer caudal peduncle, and in the fact that the ventrals are inserted ahead of the dorsal. From *Scopelarchus* it is further differentiated by having the pectoral fin shorter, smaller, and with much weaker rays than the stout pelvic fins. It can be separated from *Scopelarchoides* by the normal musculature of its abdominal walls which contrasts so strongly with the peculiar and apparently characteristic abdominal musculature of the latter (see Parr, 1929 and 1931). In common with this genus, however, it has weak pectoral fins and very stout ventral fins.

Neoscopelarchoides can be separated from the genus *Benthalbella* by the fact that the former has teeth on the vomer and palatine while the latter does not. From *Promacheon* the new genus differs in the absence of enlarged teeth of any kind on the premaxillary, in contrast to the striking dentition on the premaxillary of the former (see Weber, 1913, and Weber and Beaufort, 1913).

NEOSCOPELARCHOIDES DENTATUS, new species

FIGURE 67

Types.—Holotype, a specimen 162 mm in length without caudal, from station 102C, taken January 29, 1929, latitude 56°22′ N., longitude 145° 54′ W., U.S.N.M. no. 108145, and 12 paratypes ranging in length without caudal from 42 to 97 mm, taken at the following stations: 172C; 220C; 237B; 333C; 337B; 389B; 633B; 1028B; 1110C; 1117B; 1134C.

Those paratypes in the United States National Museum bear numbers 108168–108176.

Description.—(In the following description the count or proportion of the holotype is given, followed by the range and average of the specimens in parentheses.) Dorsal rays 7 (6 to 7; 6.9); anal rays 20 (17 to 21; 18.9); caudal rays 45 (43 to 46; 44.9); pectoral rays 23 (22 to 25; 23.5); pelvic rays 9 (9); scales in a lateral series 56 (56 to 58;

56.9); branchiostegal rays 9 (8 to 9; 8.9). Proportions of length without caudal: Length of head 4.9 (4.7 to 5.5; 5.15); snout to dorsal 2.5 (2.4 to 2.6; 2.52); snout to adipose 1.2 (1.2); snout to pelvics 3.0 (2.6 to 3.0; 2.72); snout to anal 1.6 (1.5 to 1.6; 1.55); greatest depth 8.1 (7.5 to 9.2; 8.10); length of caudal peduncle 4.3 (4.2 to 5.0; 4.73); dorsal origin to base of middle caudal rays 1.6 (1.6 to 1.7; 1.65); anal origin to base of the middle caudal rays 2.8 (2.8 to 2.9; 2.83). Proportions of length of head: Diameter of eye 3.7 (2.7 to 4.0; 3.26); length of snout 3.3 (2.4 to 3.3; 2.76); length of upper jaw 1.4 (1.3 to 1.6; 1.40); interorbital space 26.9 (6.7 to 26.9; 10.83); depth of caudal peduncle 3.9 (3.9 to 4.6; 4.20).

The body is long, slender, and moderately compressed. It is completely covered with scales. In the specimens less than 74 mm in

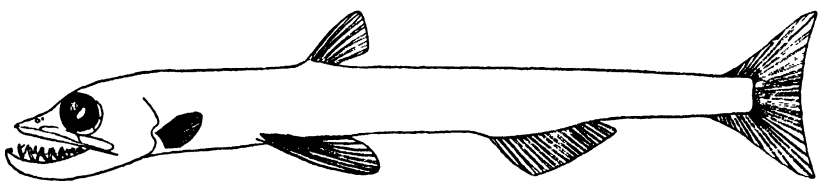


FIGURE 67.—*Neoscopelarchoides dentatus*, new genus and species: Holotype (U.S.N.M. no. 108145), 162 mm long, from station 102C.

length the scales have not yet formed. The scales along the lateral line are considerably enlarged. The small specimens (less than 74 mm in length without caudal) all have a characteristically translucent abdominal cavity. If the fish is held toward a light, the shape of its visceral organs can be plainly seen. The head is moderately compressed and is scaleless. The nostrils are a little nearer the snout than the eyes. The eyes, even in the small specimens, are distinctly telescopic. They look dorsally and anteriorly. Around their ventral two-thirds they are encased in black pigment. Below and behind the lens, but on the eyeball, is an oval patch of pearly white material, similar in appearance to the luminescent patches found on the genus *Diaphus*. There are no other luminescent bodies on the fish. The eyes are separated by only a very narrow interorbital space. In the smaller specimens the interorbital space is proportionately much wider than in the larger specimens because of the fact that a specimen 42 to 43 long has an interorbital space of the same width as one 162 mm long. The lower jaw extends far behind the eye, almost to a vertical from the upper end of the opercle.

The bones of the mouth bear a surprising array of teeth. There are (in the holotype) 10 teeth in a single series on the glossohyal. The most anterior one of these arises ventrally to the bases of the others, on the very tip of the tongue. It is about twice as long as the others and more recurved. The remaining nine are short and stout, not

especially enlarged and not barbed or hooked. They are not compressed. They bear no resemblance to the peculiar glossohyal teeth of the *Scopelarchus anale* as depicted by Parr (1929, fig. 4). Along the full length of the premaxillary is a single series of minute recurved teeth. These are so small that on the anterior two-thirds of the bone they do not project through the skin. The teeth on the dentary are similar to those shown by Parr (1929, fig. 2) for *Scopelarchus anale*. On the holotype and the larger paratypes the teeth at the symphysis are much reduced. On the palatine there is a double row of teeth. The anterior three in the inside row are enlarged and have the same shape as the fangs on the dentary. The other teeth grow progressively smaller posteriorly. Exterior to and slightly anterior to each of the teeth in this row, except the anterior fang, there is a smaller tooth. These form the incomplete second row. There is a small stout tooth on the outer angle of each side of the vomer. The teeth on the dentary and palatine are depressible. Those on the glossohyal and the vomer are not.

The dorsal is inserted nearer to the insertion of the pectorals than the origin of the anal. The fin is short; the rays are slight. The pectoral fins are small and have fine rays. They are inserted obliquely just above the articulation of the lower jaw and the quadrate, with the upper ray midway between the ventral outline and the lateral line. The pelvic fins are inserted slightly ahead of the dorsal fin. Their rays are stout and broad; the fins are much longer and larger than the pectorals. The anal is moderately long and high. The caudal fin is long and distinctly forked. It consists of 11 or 12 short rays extending along the dorsal side of the caudal peduncle, 22 stout rays forming the fin proper, and 11 to 13 short rays running along the ventral edge of the caudal peduncle. The caudal peduncle is as long as or longer than the length of the head.

Remarks.—This species is evidently distributed widely in the Gulf of Alaska. The holotype was taken in the middle of the Gulf, about 200 miles south of Cape St. Elias, the nearest land. The longest paratype was captured southeast of Kodiak Island. The rest of the paratypes were captured along the outer coast of southeastern Alaska and British Columbia from the latitude of Cape Scott on Vancouver Island to midway between Salisbury Sound and Cape Cross on Chichagof Island. All the specimens were taken outside the 100-fathom line over deep water. None of the specimens was taken in the upper ("A") nets, 6 were taken in the middle ("B") nets, and 7 were captured by the lower ("C") nets. This indicates that the species lives in a bathypelagic habitat.

This species is differentiated from the other fishes of this relationship under the discussion of the new genus. It is named in reference to its striking dentition.

Order XENOBERYCES

Family MELAMPHAIDAE

Genus MELAMPHAES Günther, 1864

MELAMPHAES CAVERNOSUS, new species

FIGURE 68

Types.—Holotype, a specimen 70 mm in length without caudal, from station 824C, taken June 8, 1932, latitude 56°06′ N., longitude 152°09′ W., U.S.N.M. no. 108147, and 3 paratypes, ranging in length from 56 to 70 mm from station 429D, U.S.N.M. no. 108157, and station 1119C.

Description.—(In the following description, the proportions and counts of the holotype are given, followed by range of the specimens in parentheses.) Dorsal rays III–16 (15 to 16); anal rays I–8 (8 to 9); caudal rays IV–19–III (III to V–19–III); pectoral rays 16 (15 to 16); pelvic rays I–7 (I–7); scales in a lateral series 29 (29 to 31); gill rakers on lower part of anterior arch 15 (15 to 16). Proportions of the length without caudal: Length of the head 2.7 (2.7 to 2.8); snout to dorsal 2.3 (2.3 to 2.4); snout to pelvic insertion 2.3 (2.3 to 2.4); snout to anal 1.5 (1.5); greatest depth 3.2 (3.2 to 3.4); length of pectoral fins 3.2 (3.2 to 3.3); length of pelvics 4.7 (4.3 to 5.4); length of caudal peduncle 3.7 (3.7 to 3.9); base of dorsal 3.9 (3.3 to 4.0). Proportions of the length of the head: Diameter of eye 6.2 (6.2 to 7.1); length of snout 3.7 (3.6 to 4.3); length of upper jaw 2.4 (2.1 to 2.5); length of pectoral fins 1.2 (1.1 to 1.2); length of pelvics 1.7 (1.5 to 1.9); depth of head 1.2 (1.2 to 1.3); depth at pectoral insertion 1.2 (1.1 to 1.2); depth of caudal peduncle 3.2 (3.1 to 3.3); interorbital space 2.0 (2.0 to 2.4); base of dorsal 1.4 (1.2 to 1.4); base of anal 4.3 (3.6 to 4.3). Depth of caudal peduncle divided into the length of caudal peduncle 2.6 (2.3 to 2.6).

The cavernous head does not bear prominent ridges or spines. The mouth is distinctly oblique. The maxillary ends under the middle of the eye. No rostral spine is present. There are teeth in bands on both jaws. The preopercle is armed with two weakly developed spines at its lower angle. The opercle is scaled. Pseudobranchiae are present. The pelvic fins are inserted slightly ahead of the pectorals. The anal fin originates under the last or next to last dorsal ray.

Remarks.—This species is closely related to *Melamphaes macrocephalus*, *M. microps*, and *M. lugubris*. From *M. macrocephalus*[1] it is differentiated by the lack of a rostral spine; by the smaller head (2.7 to 2.8 in length without caudal in *M. cavernosus*, 2.0 to 2.3 in

[1] Measurements taken from Parr, 1931.

M. macrocephalus); the wider interorbital space (2.0 to 2.4 in *M. cavernosus*, 2.6 to 3.0 in *M. macrocephalus*); and by the shorter maxillary (ending below the middle of the eye in *M. cavernosus* and beyond a vertical from the posterior margin of the eye in *M. macrocephalus*).

From *M. microps* [3] this species is separated by the deeper body (3.2 to 3.4 in length without caudal from *M. cavernosus*, 4.75 to 5.0 in *M. microps*); the wider interorbital space (2.0 to 2.4 in head in *M. cavernosus*, 3.0 to 3.25 in *M. microps*); the shorter maxillary (ending under the middle of the eye in *M. cavernosus*, under or beyond the

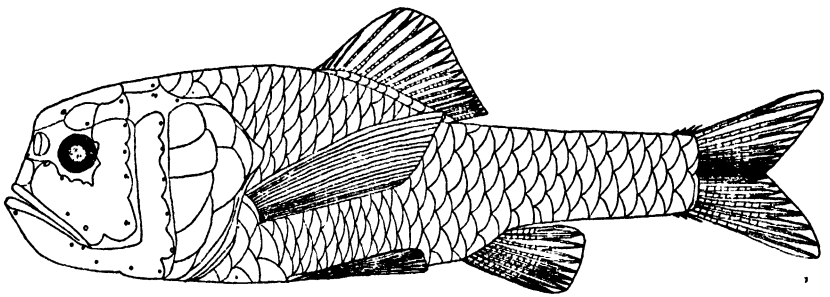


FIGURE 68.—*Melamphaes cavernosus*, new species: Holotype (U.S.N.M. no. 108147), 70 mm long, from station 824C.

posterior margin of the eye in *M. microps*); more rays in the pectoral (15 to 16 in *M. cavernosus*, 14 in *M. microps*); longer caudal peduncle (3.7 to 3.9 in length without caudal in *M. cavernosus*, 4.25 to 4.5 in *M. microps*). From the subspecies *M. microps longivelis*, described by Parr (1933), this species is easily told by the longer caudal peduncle (3.7 to 3.9 in length without caudal in *M. cavernosus*, about 5.0 in the other).

This species is distinguished from *M. lugubris* [3] by the greater number of scales in a longitudinal series (29 to 31 in *M. cavernosus*, 26 to 27 in *M. lugubris*); by the wider interorbital space (2.0 to 2.4 in head in *M. cavernosus*, 3.0 in *M. lugubris*); shorter maxillary (ending under middle of eye in *M. cavernosus* ending below posterior border of eye in *M. lugubris*); wider pectoral fin (16 rays in *M. cavernosus*, 14 ? in *M. lugubris*); longer caudal peduncle (3.7 to 3.9 in length without caudal in *M. cavernosus*, 5.0 in *M. lugubris*); and in the position of the origin of the pelvics (behind the insertion of the pectorals in *M. cavernosus*, ahead in *M. lugubris*).

The portion of the key to the species of this genus, published by Norman (1929) and added to by Parr (1931 and 1933), dealing with the above species should be modified as follows in order to accommodate this new species:

[3] Measurements from Norman, 1929.

x. Head 2⅔ to 3⅓ in the length without caudal; origin of pelvic a little behind or below pectoral base; eye 5 to 6¾ in head; depth 3½ to 4 in length; interorbital width 3 to 3¼ in head---**M. microps**

xx. Head 2⁷/₁₀ to 2⅔ in length without caudal; origin of pelvic a little behind pectoral base; eye 6⅓ to 7¹/₁₀ in head; depth 3.2 to 3.4 in length; interorbital width 2 to 2.4 in head------**M. cavernosus**

xxx. Head 2½ in the length without caudal; origin of pelvic a little in front of pectoral base; eye 6 to 6½ in head; depth 3½ to 4 in the length; interorbital width 3 in head----------**M. lugubris**

xxxx. Head 2 to 2½ in length without caudal; origin of pelvic a little in front of pectoral base; eye 8⅔ to 9¾ in head; depth 3½ in length; interorbital width 2¾ to 3 in head----------**M. macrocephalus**

Named in reference to the cavernous nature of the bones of the head.

MELAMPHAES RUGOSUS, new species

FIGURE 69

Holotype.—A specimen 94 mm in length without caudal, from station 453D.T., taken June 16, 1931, latitude 55°32′ N., longitude 136°25′ W., U.S.N.M. no. 108141.

Description.—Based upon the holotype, the only specimen known. Dorsal rays III–12, anal rays I–9; pectoral rays 13, pelvic rays I–7; caudal rays III–19–III; scales in a lateral series 25; gill rakers on the anterior arch 9 above, 22 below. Proportions of the length without caudal are: Length of head 2.7; snout to dorsal origin 2.0; snout to insertion of pectorals 2.6; snout to insertion of ventrals 2.5; snout to anal origin 1.6; greatest depth of body 3.4; length of pectoral fin 3.1; length of ventral fin 5.2; length of caudal peduncle 3.5; base of dorsal fin 3.9; base of anal fin 7.2. Proportions of the length of the head: Diameter of eye 5.8; interorbital width 2.1; length of snout 3.5; length of maxillary 2.3; length of pectoral fin 0.9; length of ventral fin 1.9; greatest depth of body 1.3. The caudal peduncle is 2.7 times as long as the least depth. The maxillary extends to the posterior border of orbit. The pectoral origin lies a little in front of the insertion of the ventrals. The anal originates under the ninth dorsal ray. There are scales on the operculum. The preopercular margin is vertical. The head is rough and cavernous. A high thin ridge with many small spines runs on either side of the top of the head from the nape to a perpendicular through the anterior margin of the orbit; a similar nearly horizontal ridge over the eye extends a distance equal to the diameter of the eye anterior to the orbit; a third slightly oblique ridge of the same length runs under the eye; and a fourth, less prominent, ridge behind the eye joins the posterior ends of the supra- and infraorbital ridges. A rostral spine is present (2.9 mm long). The long gill rakers (longest 7 mm) are toothed on their inner margins. Pseudobranchiae are present. The dentition is very weak. There are

no teeth on the tongue or maxillary and only tiny patches on the vomer and palatine. The dentaries and premaxillaries each bear a thin band of villiform teeth. The origin of the dorsal fin is a little closer to the snout than to the base of the middle caudal rays. The distance from the origin of the anal to the snout is contained 1.5 times in the distance from the origin to the base of the middle caudal rays.

Remarks.—This species is related to that group of species of the genus that have more than 20 scales in a lateral series and also have a distinct rostral spine. This group contains *M. megalops*, *M. macro-*

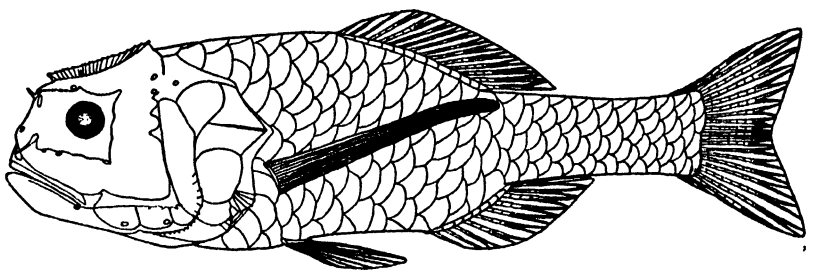


FIGURE 69.—*Melamphaes rugosus*, new species: Holotype (U.S.N.M. no. 108141), 94 mm long, from station 453D.T.

cephalus, *M. cristiceps*, *M. crassiceps*, *M. atlanticus*, *M. nigrofulvus*, *M. unicornis*, and *M. triceratops*. From *M. megalops* [3] it is distinguished by the deeper caudal peduncle (2.4 as long as deep in *M. rugosus*, 4.0 to 4.5 in *M. megalops*); larger eye (5.8 in head in *M. rugosus*, 3.5 to 3.75 in *M. megalops*); and the more posterior insertion of the ventrals (behind the pectoral base in *M. rugosus*, ahead of the base in *M. megalops*).

It is separated from *M. macrocephalus* [2] by the larger eye (5.8 in head for *M. rugosus*, 8.5 to 9.4 for *M. macrocephalus*); wider interorbital space (2.1 in head in *M. rugosus*, 2.66 to 3.0 in *M. macrocephalus*); and the more posterior insertion of the pelvics.

From *M. cristiceps* [3] it is distinguished by the larger eye (5.8 in head in *M. rugosus*, 7.0 to 8.5 in *M. cristiceps*); the wider interorbital space (2.1 in head in *M. rugosus*, 3.25 to 3.5 in *M. cristiceps*); and by the smaller pectoral fin (13 rays in *M. rugosus*, 14 to 15 in *M cristiceps*).

From *M. crassiceps* [3] *M. rugosus* is distinguished by the size of the eye (5.8 in head in the latter, 7.0 to 8.5 in the former); and by the wider interorbital space (2.1 in *M. rugosus*, 3.25 to 3.5 in *M. crassiceps*).

It can be told from *M. atlanticus*,[3] to which it seems most closely related, by the deeper body (3.4 in length without caudal in *M. rugo-*

[2] Measurements taken from Parr, 1931.
[3] Measurements from Norman, 1929.

sus, 3.8 to 4 in *M. atlanticus*); wider interorbital (2.1 in head in *M. rugosus*, 3.25 in *M. atlanticus*); smaller pectoral fin (13 rays in *M. rugosus*, 15 in *M. atlanticus*).

M. rugosus can be differentiated from *M. nigrofulvus* [3] by the shorter head (2.7 in length without caudal in *M. rugosus*, 2.25 to 2.5 in *M. nigrofulvus*); more anterior insertion of dorsal (snout to dorsal origin less than from dorsal origin to base of caudal in *M. rugosus*, greater in *M. nigrofulvus*); more anterior insertion of anal fin (distance from snout to anal origin less than from origin to base of anal in *M. rugosus*, greater in *M. nigrofulvus*).

From *M. unicornis* [3] it can be separated by the wider interorbital space (2.1 in head in *M. rugosus*, 4.66 in *M. unicornis*); and larger eye (5.8 in head in *M. rugosus*, about 7.0 in *M. unicornis*). Finally, it differs from *M. triceratops* by the lack of the prominently projecting horizontal spine anteriorly, characteristic of that species, and the longer dorsal (III, 12 in *M. rugosus*, III, 10–11 in *M. triceratops*).

The portion of the key referred to above, which includes these species, should be modified as follows to include this species:

B. A spine on the middle of the snout between the nostrils or anterior parts of eyes; origin of anal below posterior half of dorsal.
 1. Origin of pelvic a little in front of pectoral base; caudal peduncle 4 to 4½ times as long as deep; diameter of eye 3½ to 3¾ in head **M. megalops**
 2. Origin of pelvic slightly in front of pectoral base; caudal peduncle 2 to 2½ times as long as deep; diameter of eye 8½ to 9½ in head; head 2 to 2½ in length without caudal **M. macrocephalus**
 3. Origin of pelvic below or a little behind pectoral base; caudal peduncle 2¼ to 3 times as long as deep.
 a. Dorsal III, 12–15; origin nearer end of snout than base of caudal; interorbital width 2 to 3½ in head.
 x. Diameter of eye 7 to 8½ in head; maxillary extending to a little beyond the posterior margin of the eye; head 2½ to 2¾ in length without caudal.
 o. Head 2¾ to 2⅞ in the length without caudal; last ray of dorsal behind vertical from middle of anal fin base; caudal peduncle 2½ to 2⅞ as long as deep .. **M. cristiceps**
 oo. Head nearly 3 in the length; last ray of dorsal a little in front of vertical from middle of anal; caudal peduncle nearly 3 times as long as deep **M. crassiceps**
 xx. Diameter of eye 5⅞ to 6¼ in head; maxillary extending to below posterior ¼ of eye; head 2⁷⁄₁₀ to 3 in length without caudal; caudal peduncle 2¾ to 3 times as long as deep.
 p. Interorbital 2¹⁄₁₀ in head; pectoral with 13 rays ... **M. rugosus**
 pp. Interorbital 3¼ in head; pectoral with 15 rays ... **M. atlanticus**
 b. Dorsal III, 10–12; origin a little nearer base of caudal than end of snout; caudal peduncle 2½ to 2½ times as long as deep; head 2¼ to 2½ in length without caudal.
 x. Interorbital width about 3 or less; eye 6 in head **M. nigrofulvus**

[3] Measurements from Norman, 1929.

xx. Interorbital width about 4⅘; eye 7 in head.....M. unicornis
c. Dorsal III, 10–11; origin nearer end of snout than base of caudal; frontal crests each with a prominently projecting horizontal spine anteriorly; caudal peduncle about 2½ times as long as deep; head 2¼ to 2⅔ in length without caudal.....M. triceratops

Named in reference to the rough and spinous nature of the head.

Order PEDICULATA

Family ONEIRODIDAE

Genus ONEIRODES Lütken, 1871

ONEIRODES BULBOSUS, new species

FIGURE 70

Holotype.—A specimen 57 mm in length without caudal, from station 1109C, taken March 11, 1934, latitude 53°50′ N., longitude 133°54′ W. (about 25 miles WSW. of Frederick Island, one of the Queen Charlotte Islands), U.S.N.M. no. 108149.

Description.—The body and all it appendages, except the bulb of the illicium, are jet black. The form is deep, wide, and nearly bulb-shaped. The greatest depth (at a vertical from in front of the isolated dorsal ray) is equal to the breadth of the fish between the downward projecting spines at the posteroventral corner of the opercular apparatus. The sphenotic spines are well developed. They project from the surface of the head to a height a little greater than the diameter of the tiny eye. They arise at a vertical well behind the eye. The cheek is a large roughly triangular concavity formed by a ridge running from this spine down along the preoperculum and the upper jaw. A little above the center of this concavity the tiny eye projects from the skin to a height equal to its diameter. Between the two sphenotic spines there is a large, deep concavity that extends from behind the level of those spines to the basal bone of the illicium. At the level of the sphenotic spines this cavity is 7 mm wide and 5 mm deep (8.1 and 11.4 in the length without caudal respectively). The bottom of the cavity is a dark brown, distinctly lighter than the rest of the body. The walls of the cavity are formed by the frontal bones. The upper and lower jaws are both heavy. The former extends back to a vertical between the eye and the sphenotic spine; the latter projects slightly and is provided with a rounded mental knob. Posterior to the corner of the mouth, and below its level, there is a sharp stout spine of about the same size and shape as the sphenotic spine, which projects outward and downward at an angle of about 80° with the head. Below this there is a broad, heavy, flat, triangular spine, which projects downward at the posteroventral corner of the opercular apparatus nearly to the ventral outline.

In the lower jaw there are 11 teeth on the left side, 10 on the right. These teeth are unequal in size and irregularly spaced in a single row. They are long and slender, are depressible, and slant inwardly. There are 12 teeth in each upper jaw, similar to those in the lower jaw but not so long or strong. There is a bare space 8 mm wide at the junction of the premaxillaries. There are 2 teeth on the right side of the vomer and 3 on the left.

The illicium is 17 mm long, the basal bone 7 mm (3.4 and 8.1, respectively, in the length without caudal). The basal bone projects slightly beyond the snout. The bulb of the illicium bears 4 projections

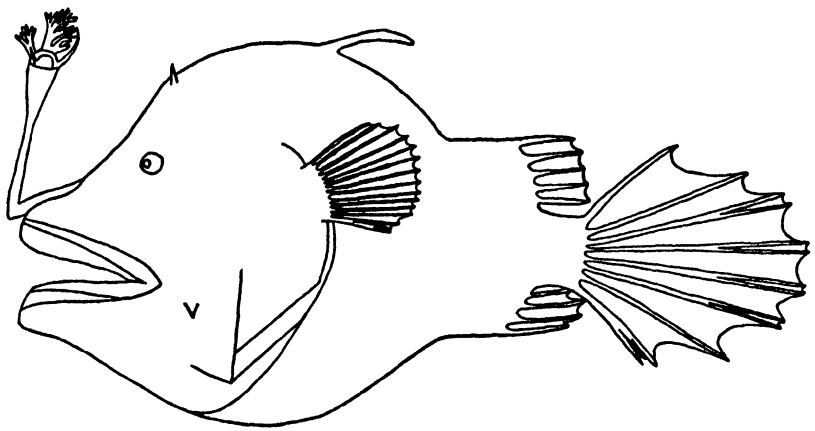


FIGURE 70.—*Oneirodes bulbosus*, new species: Holotype (U.S.N.M. no. 108149), 57 mm long, from station 1109C.

arranged in an anteroposterior line across its top. The first one anteriorly is a short tentacle from whose end branch several bifid or trifid secondary tentacles. The next two are arranged bisymmetrically on either side of the midline behind the one just mentioned. They each branch and rebranch several times to form a large clump of moderately long secondary tentacles. Behind these and past the center of the midline is a small round projection which bears no tentacles. Lastly there arises just above the edge of the pigment line posteriorly a long slender tentacle that bears no secondary tentacles but is curved anteriorly so that its end lies in the above mentioned double clump of tentacles. There is no pigment on the bulb or tentacles. Between the posterior two projections on the bulb there is a small pore.

The isolated dorsal ray is located at a vertical from the base of the pectoral. It is fleshy and lax and is 9 mm long. The soft dorsal consists of 5 rays, none of which is bifid. It is inserted far back on the body, at the same vertical as the anal, and its base slopes sharply down to the short caudal peduncle behind. The caudal contains 8 rays.

Its formula is 2–4–1–1; that is, the two dorsal rays are simple, the next four bifid, the next one simple, and the ventralmost bifid. The anal has 4 rays, none of which is bifid. Its base is considerably shorter than that of the dorsal. The pectorals contain 13 rays, the ventral one of which is bifid. The ventral ray on the left fin is trifid, with one division deeper than the other so that there at first appear to be 14 rays in this fin. Directly behind and below this fin is the gill opening, which is 6 mm high. The vent is a short distance ahead of the origin of the anal.

Remarks.—Regan (1926, pp. 26, 27) has limited the genus *Oneirodes* to those members of the family Oneirodidae having the premaxillaries not particularly protracted, the illicium near the end of the snout, followed by an isolated simple ray that appears on the middle of the back. To this genus, then, he leaves *Oneirodes eschrichtii*, noting that *O. niger* Brauer and *O. cornutus* Gilchrist probably are species of the genus *Dolopichthys*. *Oneirodes bulbosus* differs from *O. eschrichtii* in having 13 instead of 17 pectoral rays, 5 dorsal rays instead of 6. From the picture of the latter species given by Regan (1926, p. 26) the new species differs in having the sphenotic spine posterior to the eye, the maxillary not extending posteriorly to a vertical from the sphenotic spine, the basal bone of the illicium projecting past the snout, in having the above mentioned spine below and behind the corner of the mouth, and in several other characters such as the gill opening extending down only a small distance from the base of the pectoral. The structure and the position of the appendages of the illicium are quite different from those shown for *O. eschrichtii*.

It is believed that this is the first example of the genus *Oneirodes* taken in the Pacific Ocean. Besides *Dolopichthys thompsoni* Schultz, which likewise was taken by the International Fisheries Commission (Schultz, 1934), this species is the only member of the suborder Ceratoidea that has been taken from the northeastern Pacific Ocean.

Named in reference to the nearly spherical shape of the body of the fish.

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NEW SPECIES OF MOTHS OF THE FAMILIES NOTODONTIDAE AND BOMBYCIDAE IN THE UNITED STATES NATIONAL MUSEUM

By WILLIAM SCHAUS

THIS paper contains the descriptions of 34 new species of moths, some of the specimens being received from friends for identification and some gained by purchase. Twenty-four of the species are from various parts of Brazil, the remaining ten from scattered localities in Central and South America. Twenty-six are assigned to the family Notodontidae; eight belong to the Bombycidae, one in the subfamily Epiinae and seven in Zanolinae. The material is all in the United States National Museum.

Family NOTODONTIDAE

Genus PRONERICE Schaus

PRONERICE LUDECIA, new species

Female.—Head and collar mottled fuscous, buffy olive and white, the patagia with numerous white-tipped scales; abdomen above buffy olive with faint pale transverse lines, underneath shell pink with dark olive-buff transverse lines. Fore wing dark citrine with a brownish tinge; costal margin with transverse black lines and white points before apex; veins from cell finely darker; an antemedial irregular black line; a white line on discocellular; a postmedial black line, partly punctiform, lunular from vein 3 to inner margin; a subterminal

sinuous fine white line expanding at apex; terminal small white streaks on interspaces. Hind wing dull buffy brown; a small white line above anal angle; cilia white. Wings below brownish drab; fore wing with the costa finely, the termen narrowly pale vinaceous-pink; hind wing deep olive-buff, the outer margin broadly brownish drab; the termen vinaceous-pink.

Expanse, 60 mm.

Habitat.—Hansa Humboldt, Brazil.

Type.—U.S.N.M. no. 34725.

Genus NYSTALEA Guénée

NYSTALEA DAHNI, new species

Male.—Head and collar saccardo's umber, with a posterior lateral black spot; thorax concealed by the patagia, which are hair brown streaked with fuscous; metathorax black with lateral tufts of long white hairs; abdomen dorsally with black tufts at base, the following segments grayish olive with transverse black lines, underneath white, at base faintly vinaceous. Fore wing mostly light cinnamon-drab mottled with light yellowish olive; base narrowly white outwardly edged by a black line from costa to median vein; short antemedial paired lines on costa; a fine medial, sinuous, black line, inbent on inner margin toward base; a subterminal black line forming three lunules from costa to inner margin, the two upper lunules proximally edged with white, the upper lunule joined by a dark outbent shade from costa, the middle lunule preceded by a fuscous vertical streak; the small lunule on inner margin with only a little white proximally; the lunules outwardly edged with white on costa and from vein 4 to inner margin; an irregular terminal black line, somewhat dentate before tornus; cilia mostly white with black spots. Hind wing white at base, the termen broadly hair brown, the veins postmedially with fine dark lines. Fore wing below yellowish white, the veins from cell finely black; a smoky medial streaky shade; white points on costa before apex; a subterminal black line parallel with termen, which is white with black lines on veins. Hind wing below white with faint yellowish suffusions on costa; subterminal small black spots on veins, a larger spot at veins 3 and 4.

Expanse, 51 mm.

Habitat.—Espirito Santo, Brazil.

Type.—U.S.N.M. no. 34711.

Two paratypes from the same locality.

Allied to *N. multiplex* Dognin.

Genus PROELYMIOTIS Schaus

PROELYMIOTIS SUTILANS, new species

Male.—Palpi buff above, fuscous underneath. Head and collar mottled gray and brown, the patagia warm buff, dorsally fringed with dark brown. Abdomen dorsally drab, with pale transverse lines, the last segment and claspers ecru-drab, underneath brownish drab at base becoming whitish with dark transverse lines. Fore wing warm buff with deep olive-buff suffusions and irrorations, the veins with fine dark streaks; a subbasal fine dark angled line; antemedial line, almost medial, double, irregularly outcurved, above inner margin inbent toward base; a black point at each end of discocellular; the veins on outer half with fine dark streaks, interrupted by the pale postmedial line, which is outcurved on costa, somewhat sinuous, and incurved to inner margin; termen with a faint darker angled line from apex to vein 3, below the vein to vein 4 with an inbent fuscous line, and below vein 4 a small fuscous lunule, the tips of veins mostly with white and black scales. Hind wing pale olive-buff with terminal irregular deep olive-buff suffusions, and a similar median broken fascia. Wings below colonial buff, a faint dark streak below costa of fore wing.

The female has the hind wing entirely hair brown, with the cilia white; the wings below almost entirely suffused with citrine-drab.

Expanse, male 36 mm., female 45 mm.

Habitat.—Hansa Humboldt, Santa Catharina, Brazil.

Type.—U.S.N.M. no. 34735.

The species is somewhat variable.

Genus TACHUDA Schaus

TACHUDA ERNEA, new species

Male.—Head and thorax hair brown, metathorax white with irregular black lines; abdomen above light drab, the basal segment partly vinaceous, underneath whitish. Fore wing base broadly hair brown expanding on costa with grayish scaling at base, and with faint paler spots on costa, and an irregular subbasal black line; antemedial line double, black, very irregular, filled in with some white scales from cell to inner margin; an irregular black medial line with a distinct white-edged line on discocellular; a double postmedial black lunular line filled in with white scaling, inbent from costa to vein 3 and excurved to inner margin closely followed by a series of dark lunules, these lines preceded and followed by vinaceous-buff shading; subterminal black lunules basally white edged, the tips extending on either side of veins to termen; an interrupted terminal black line; cilia mottled white and brown. Hind wing above pale wood brown slightly whitish at base.

Fore wing below vinaceous-drab, the costal edge finely pale vinaceous, also the termen below apex, the inner margin whitish. Hind wing below partly white, the costal margin and termen slightly vinaceous.

The female differs only in the white shading at costa before the postmedial line, and a short white streak at apex, this variability existing no doubt in both sexes.

Expanse, male 33 mm., female 34 mm.

Habitat.—Itatiaya Est do Rio, Brazil.

Type.—U.S.N.M. no. 34704.

Genus SALLUCA Schaus

SALLUCA DURANI, new species

Male.—Head and collar mottled vinaceous-fawn and wood brown; thorax fuscous concealed by the white patagia; abdomen above fawn color with paler transverse lines; anal hairs seashell pink; thorax below and abdomen white, the latter with dark, fine, transverse lines. Fore wing light buff, the markings cinnamon-buff; an antemedial outcurved series of small spots; a less intensive series of medial spots, the space between these two lines buff pink; a small white crescent, darkly edged, at end of cell; an irregular series of small, subterminal, triangular points; cilia with white spots on interspaces. Hind wing light buff, the margins broadly vinaceous-fawn. Wings below whitish buff, the apex of fore wing suffused with vinaceous-fawn.

Expanse, 40 mm.

Habitat.—Hansa Humboldt, Santa Catharina, Brazil.

Type.—U.S.N.M. no. 34705; also a paratype in the collection.

Closely allied to *S. schausi* Dognin.

SALLUCA DEFLECTANS, new species

Male.—Palpi black, fringed with roseate and clay color, the vertex partly fuscous; collar anteriorly pinkish buff, posteriorly deep greenish olive; thorax white thickly irrorated with sorghum brown. Abdomen above dorsally army brown, paler laterally, the middle segments with paler transverse lines, the last segments and underneath pinkish buff. Fore wing with a fuscous line at base of costa, below it a whitish line upbent to costa, along which it extends to near apex, medially expanding to a triangular space edged below with buffy olive, the inner margin and termen paler; subterminal dark points on interspaces; a dark-angled terminal line mostly finely edged by pale lines proximally; cilia with olive-brown spots. Hind wing with inner margin tawny-olive; costa and a postmedial line from costa to anal angle avellaneous cut by the veins; termen broadly buffy brown; cilia whitish. Fore wing below dark olive-buff suffused with light cinnamon-drab, the

costal edge, termen narrowly, and inner margin broadly white. Hind wing below white, the costa suffused with light cinnamon-drab.

Expanse, 60 mm.

Habitat.—Espirito Santo, Brazil.

Type.—U.S.N.M. no. 34736.

Quite different from any species described.

Genus DISPHRAGIS Hübner

DISPHRAGIS COREMISTA, new species

Male.—Head and thorax dull green, the tegula crossed and edged by black. Abdomen above dull reddish at base, then somewhat fuscous with faint greenish dorsal scales, the next to last segment testaceous, posteriorly with biscay-green scaling and two small fuscous spots. Fore wing dull citrine with darker suffusions; subbasal and antemedial fine, double, black lines faintly lunular; a similar postmedial line sinuous, incurved below vein 2; subterminal paired black points on interspaces; small black spots on cilia at veins. Hind wing flesh ocher, the inner margin dull red, the termen with darker, duller suffusions; cilia on termen and inner margin white. Fore wing below light ochraceous-salmon with a darker streak below costa not reaching termen, the base, tornus, and termen white; cilia with fine dark streaks at veins. Hind wing below white, with faint roseate suffusions below costa.

Expanse, 36 mm.

Habitat.—Hansa Humboldt, Brazil.

Type.—U.S.N.M. no. 34720.

DISPHRAGIS BACTRINA, new species

Male.—Head dark green; collar fuscous anteriorly then dull cinnamon tipped with white; thorax and patagia light green, the patagia with black lines laterally; abdomen at base cinnamon-drab, the following segments fuscous with slight cinnamon-drab segmental lines. Fore wing above: Some pale green at base and a wavy black basal line, followed by a broad saccardo's olive space with a small green space below cell, this space outwardly edged by a sinuous black line, which is followed from cell to inner margin by a pale-green space limited by a series of small black spots from cell medially to tornus; a faint cinnamon-buff shade above the oblique series of spots; apical space roman green preceded by dark reddish suffusions and a greenish oblique line inbent from apex with fuscous green spots below it; termen from vein 4 to tornus yellowish green with subterminal paired dark spots. Hind wing olive-drab, with a fuscous streak along the

inner margin; cilia vinaceous. Wings below white, the fore wing with faint subterminal dark spots on interspaces.

Expanse, 35 mm.

Habitat.—Espirito Santo and São Paulo, Brazil, the specimen from the latter place from the Dognin collection.

Type.—U.S.N.M. no. 34713.

The species is closely allied to *D. bactrea* Schaus (=*D. crocea* Dognin) from the Amazons and Guianas.

DISPHRAGIS HANDLEYI, new species

Female.—Head and collar mottled light buffy brown and fuscous; thorax medially black, the patagia mottled with dull green, dorsally edged with black; abdomen dorsally dull buffy citrine, underneath ecru-drab. Fore wing olive-citrine, somewhat darker antemedially; fine darker lines on costa; traces of postmedial and subterminal lines outcurved on costa, the former line continues as short dark streaks on veins, the latter line with dark streaks on veins, below vein 3 with broader spots at inner margin proximally edged by a fine white line. Hind wing white, the costa broadly olive-citrine, the termen very narrowly so; some fuscous scaling along inner margin. Wings underneath white; costa of fore wing suffused with grayish olive not reaching apex; terminal small dark spots on cilia at tips of vein; on hind wing the cilia with very fine dark streaks at veins.

Expanse, 51 mm.

Habitat.—Pueblo Guasca, Colombia.

Type.—U.S.N.M. no. 34722.

Genus MALOCAMPA Schaus

MALOCAMPA MONITA, new species

Male.—Head, thorax, and abdomen above dark greenish olive, some white hairs on vertex, the patagia and anal hairs white; body below and legs white. Fore wing yellowish olive; base white with olivaceous mottling; medial space on costa and in cell with grayish-olive mottling; termen from below apex to tornus white, the proximal edge expanding irregularly and crossed by some wavy dark scaling. Hind wing white, the costa and inner margin narrowly dark olive-gray. Fore wing below silvery white with light olive-gray shading toward base; a greenish-olive streak below costa to near apex. Hind wing below light pinkish lilac, the termen white.

Expanse, 38 mm.

Habitat.—Espirito Santo, Brazil.

Type.—U.S.N.M. no. 34708; also a paratype in collection.

MALOCAMPA EDNANA, new species

Male.—Head, thorax, and abdomen above blackish brown, the abdomen with slightly paler transverse lines; the metathorax with two white spots; abdomen below light buff with darker transverse lines. Fore wing dark buffy brown, the inner margin white with some faint darker irrorations, narrow at base, then upturned to near cell, then slightly downbent toward tornus and upturned to termen to vein 4 enclosing a small buffy brown spot; a short whitish streak to apex. Hind wing buffy brown the cilia faintly pale drab-gray. Fore wing below light purple-drab; inner margin and termen to vein 4 above tornus whitish; a fine darker postmedial line and similar subterminal shading. Hind wing below lilacine white; a fine dark postmedial line and still fainter subterminal shading.

Expanse, 37 mm.

Habitat.—Espirito Santo, Brazil.

Type.—U.S.N.M. no. 34707.

Allied to *M. sida* Schaus.

MALOCAMPA GRIFFINI, new species

Male.—Palpi fuscous fringed with vinaceous-fawn; head vinaceous-fawn with a small fuscous spot; collar russet in front, posteriorly fuscous; thorax fuscous with a dorsal white line, the patagia light grayish olive; abdomen dorsally fuscous, narrowly at base, then expanding laterally, underneath and laterally at base light ochraceous-salmon. Fore wing largely olive-gray, a chamois spot at base of inner margin limited by a curved fuscous line; followed by very fine darker lines; an almost medial black point on costa, and one below it in cell, also a dark inbent streak from vein 2 to submedian; fine darker lines on postmedial space, which extends to termen from vein 5 to vein 7 with black subcostal spots at and before apex; a broad terminal fuscous space from vein 4 to tornus; termen partly crenulate with black points at tips of veins. Hind wing partly hyaline with fine dark lines on veins expanding at the narrow dark termen; inner margin broadly light ochraceous-salmon, preceded by a dark streak and white point above anal angle. Fore wing below dark grayish brown; the base pale ochraceous-buff; costal edge before apex white with four black points. Hind wing below whitish suffused with light ochraceous-salmon at base and along inner margin; termen faintly light drab.

Expanse, 58 mm.

Habitat.—Espirito Santo, Brazil.

Type.—U.S.N.M. no. 34706.

Three paratypes in collection.

MALOCAMPA OCCAMA, new species

Male.—Head and front of collar grayish white, with a few dark hairs predominating on the collar posteriorly; thorax gray with transverse dark scaling; abdomen above drab, the base and terminal segments mottled with white hairs; abdomen below mostly white. Fore wing glossy gray; a little white at base crossed by a sinuous dark line, followed on costa to antemedial line by a hair-brown patch not extending below median vein, the antemedial dark line double, lunular dentate to inner margin; an irregular medial line with two black points on it in cell and followed by an irregular narrow fuscous fascia; postmedial line double, irregular, with double black points on veins, ending at a hair-brown patch at tornus; a terminal hair brown patch from apex to vein 4 its proximal edge curved; a lunular terminal black line, and black spots on the white cilia, at tips of veins. Hind wing whitish on inner margin, the medial space with pale vinaceous-drab suffusions; termen broadly citrine-drab; cilia white. Fore wing below citrine-drab with some white at base and whitish spots postmedially; cilia white on interspaces. Hind wing below white with a narrow terminal citrine-drab shade at apex reduced to short lines on veins toward anal angle.

Expanse, 37 mm.

Habitat.—Hansa Humboldt, Santa Catharina, Brazil.

Type.—U.S.N.M. no. 34717.

Five paratypes in collection.

MALOCAMPA DELOSIA, new species

Male.—Head and thorax grayish white mottled with fuscous hairs on collar forming transverse lines; abdomen with base and terminal segments similar to thorax, the intermediate segments hair brown with drab-gray segmental lines, underside pale vinaceous-pink. Fore wing pale brownish vinaceous with darker irrorations; a subbasal lunular black line, partly double; a double antemedial line, broken by veins, outbent to postmedial line above submedian; a large triangular postmedial spot resting on costa, its apex at vein 4 continued as a narrow line to inner margin; a postmedial double series of small black spots on interspaces from vein 5 to inner margin; terminal black spots on interspaces and similar spots at tips of veins. Hind wing ecru-drab, the veins finely dark; termen narrowly drab, the cilia white. Fore wing below drab with white suffusions at base and postmedially on interspaces; cilia white with dark points at tips of veins. Hind wing below and cilia white; some ecru-drab scaling on costa.

Expanse, 39 mm.

Habitat.—Hansa Humboldt, Santa Catharina, Brazil.

Type.—U.S.N.M. no. 34718.

Three paratypes in collection.

Genus CHADISRA Walker

CHADISRA MARCIDANA, new species

Male.—Head buffy brown; collar black with some gray hairs posteriorly; thorax buffy brown, the patagia white dorsally edged by a black line. Abdomen dorsally light drab at base, the segments following darker drab with transverse white lines, the two last segments white, underneath as above. Fore wing above: Base with a narrow black wavy line followed by white with dark irrorations from below cell to inner margin; an antemedial broad hair brown triangular space from costa to apex below cell, where it becomes linear to inner margin, edged outwardly by a somewhat lunular medial line, this line adjacent to a white spot in cell; postmedial space whitish with dark streaks on costa and irregular dark spots to submedian; a postmedial black line outangled on costa from a small costal spot vertical from vein 7 to vein 6, incurved from vein 6 to vein 4, then inbent somewhat lunular, closely followed by light drab to vein 4 and divided by a narrow white line; termen rather broadly white extending basad between veins 4 and 3; a terminal lunular black line; cilia white with deep grayish-olive spots at veins. Hind wing above white on inner margin preceded by a light grayish-olive space to below cell; the medial space on costa whitish; termen citrine-drab, also the veins; termen from vein 5 to tornus with pale spots on interspaces. Fore wing below dark vinaceous-drab with terminal white spots on costa and larger spots on termen. Hind wing below silvery white, the costa and termen dark vinaceous-drab, on termen diminishing toward anal angle.

Expanse, 50 mm.

Habitat.—Espirito Santo, Brazil.

Type.—U.S.N.M. no. 34712.

Also a paratype in National Collection. Closely allied to *C. hymen* Dyar.

CHADISRA ALSOPIA, new species

Male.—Head and thorax white, mottled with light-gray hairs; abdomen above to beyond middle dusky brown, the last segments and the underside white. Fore wing white with faint grayish irrorations; a fine black basal line inangled on median closely followed by a fainter very irregular line; antemedial line well marked on costa, very fine, outcurved to median and outbent to inner margin; traces of a faint postmedial line; subterminal line from costa before apex, wavily inbent to vein 4 then fainter and sinuous to tornus; a fine

wavy terminal line. Hind wing whitish, the margins suffused with smoky gray, broader from apex to vein 3; cilia white. Fore wing below silvery white, with postmedial dark suffusions at costa. Hind wing below silvery white.

Expanse, 42 mm.

Habitat.—Santa Catharina, Brazil.

Type.—U.S.N.M. no. 34709.

Ten paratypes in collection.

Genus MERAGISA Schaus

MERAGISA GLACIDIA, new species

Male.—Head and collar white with some grayish hairs. Abdomen black, overlapped at base with drab hairs; terminal segment white with fine grayish irrorations; a fine dark and irregular subbasal line; antemedial line black, double on costa, then outbent, below costa wavily downbent, fine, partly indicated by black scales; medial line very faint with a dark point in cell; postmedial line double on costa, preceded on costa by a short fuscous streak, outbent and fine, joining the subterminal irregular lunular line; terminal line deeply lunular from apex, below vein 3 with the lunules wider apart; cilia white. Hind wing hair brown on termen, the disk with pale greenish suffusions, the cilia white. Fore wing below yellowish white on base and inner margin, the outer space broadly hair brown, the costal edge and cilia white. Hind wing below yellowish white, the costal margin and termen suffused with dark olive-buff.

Expanse, 48 mm.

Habitat.—Espirito Santo, Brazil.

Type.—U.S.N.M. no. 34728.

MERAGISA NICOLASI, new species

Male.—Head, collar, and thorax white mottled with light mouse-gray hairs. Abdomen above at base avallaneous, the following three segments fuscous with paler transverse lines, the terminal segments white, underneath white. Fore wing, white with some fine black and brownish irrorations; a fine dark angled line on costa subbasally; a small black lunule on costa antemedially, a point medially, paired black spots postmedially, and three points subterminally on costa; a slight black streak on discocellular; small postmedial lunules between veins 2 and 3 and veins 4 and 6; a deep black lunular line on termen; cilia white. Hind wing grayish olive, the inner margin broadly mustard yellow, the cilia white, wings below light grayish olive, the fore wing with the base and inner margin, the costa narrowly

white, the hind wing with the inner margin broadly white, the cilia on both wings white.

Expanse, 45 mm.

Habitat.—Jepelacio, north Peru.

Type.—U.S.N.M. no. 34734.

Allied to *M. dasra* Dognin, but very different underneath.

Genus RIFARGIA Walker

RIFARGIA MOLLERI, new species

Female.—Head deep olive-buff; collar in front fuscous, posteriorly also thorax whitish with gray vertical lines. Abdomen above vinaceous-gray, underneath white. Fore wing grayish white with dark irrorations and fine dark lines; the subbasal line wavy, partly double; antemedial line double, faintly lunular, vertical to median, then more wavy, filled in and edged with fuscous scales, expanding on inner margin; medial line double approximated across discocellular; postmedial line double, vertical from costa to vein 4, then wavily incurved followed below vein 3 by four small black spots forming part of similar spots upbent to costa before apex; a fine terminal black line; cilia whitish with black spots at veins. Hind wing white, the termen broadly deep grayish olive, the cilia white. Fore wing below deep grayish olive, faintly whitish on discocellular, the cilia white with black points at veins, and on costa near apex. Hind wing below as above.

Expanse, 40 mm.

Habitat.—Hansa Humboldt, Brazil.

Type.—U.S.N.M. no. 34730.

Described from a unique specimen.

RIFARGIA EDVINA, new species

Male.—Head dark grayish drab; collar partly clay color; thorax and patagia drab-gray; abdomen dorsally light drab, laterally drab, underneath white. Fore wing above whitish, the markings dark olive-buff; a basal patch on costa; a broad antemedial fascia below cell to inner margin where it expands toward base and is joined at cell by a narrow medial spot from costa; a postmedial black line wavily inbent to vein 3, preceded by a similar line from vein 5 forming large lunules to inner margin, these lines followed by a narrow shade from costa to vein 3, where it expands to termen filling the tornal space; a fine subterminal black line with projecting streaks on veins. Hind wing above white, the termen narrowly dark drab. Fore wing below white on inner margin and termen; below costa a blackish-brown shade from base expanding toward termen, projecting dark lines on

the veins. Hind wing below white; a short dark line below base of costa and similar terminal spots at apex.

Expanse, 42 mm.

Habitat.—Espirito Santo, Brazil.

Type.—U.S.N.M. no. 34716.

RIFARGIA VALTERIA, new species

Male.—Head heliotrope-slate with some lateral white hairs; collar pale smoke gray edged posteriorly by a fuscous line; thorax and patagia grayish white, the patagia with a lateral black line; abdomen with the base and three terminal segments grayish white, the intermediate segments deep mouse gray, underneath white. Fore wing with the basal half white with grayish irrorations limited by a deep mouse-gray thick line, outcurved on costa; a subbasal black line; an antemedial double outcurved line, dentate from costa to median then lunular; outer half of wing pale purplish gray, with the veins and a double postmedial lunular line light purplish gray; a subterminal lunular black line from costa to vein 4, then fainter and straight to inner margin; a terminal deeply lunular black line. Hind wing with basal half and inner margin whitish, the veins finely dark; termen broadly deep mouse gray. Fore wing below dark violet-gray, the base whitish, also postmedially on interspaces; costa terminally finely white also the cilia. Hind wing below white, the termen broadly dark violet gray, the cilia white.

Expanse, 48 mm.

Habitat.—Hansa Humboldt, Santa Catharina, Brazil.

Type.—U.S.N.M. no. 34715.

Two paratypes in collection.

RIFARGIA OGDENI, new species

Male.—Head and collar mottled gray and brown; thorax mottled with brown and gray hairs; abdomen above dark purple-drab with dull grayish hairs at base and on terminal segments. Fore wing grayish white at base on inner margin and at tornus; basal and subbasal irregular black lines and spots; antemedial line black, double, lunular partly filled in with buff; medial space white with fine dark irrorations; a conspicuous velvety-black spot at end of cell followed by a fine outcurved dark line and a fine double lunular postmedial line followed on costa by short black streaks; a whitish subterminal line preceded and followed by black streaks on veins; subterminal fuscous spots on interspaces and similar spots on tips of veins; some fuscous scaling at tornus. Hind wing hair brown, slightly paler at base; cilia white also a small spot above anal angle. Fore wing below hair brown with slight paler suffusions on basal half; cilia white on

interspaces. Hind wing below whitish below costa and on inner margin, the costa and termen broadly hair brown; cilia white.

Expanse, 35 mm.

Habitat.—Santa Catharina, Brazil.

Type.—U.S.N.M. no. 34714.

Also two paratypes in collection.

Genus NAVARCOSTES Schaus

NAVARCOSTES OAKLEYI, new species

Male.—Head and collar cinnamon-buff, the latter tipped with black scales; thorax vinaceous-brown, the metathorax cinnamon-buff; patagia white at shoulder; abdomen above dull taupe brown, with a quadrate tuft of fuscous scales at base, and a faint brownish-drab dorsal line, the anal hairs white; thorax below light grayish olive, the venter white on terminal half. Fore wing above with the base from costa to submedian vein crossed by a double fine black line forming two lunules; space beyond to subterminal pallid quaker drab crossed by numerous fine dark olive-buff striae; an antemedial darker antemedial shade, broad on costa, expanding on inner margin, preceded and followed on costa by short black lines and forming in cell a small spot; subterminal line slightly outcurved on costa and inbent to inner margin, parallel with termen, consisting of double black lunules on interspaces, also with a few black points, expanding distally beyond cell; termen white from vein 5 to tornus; apex suffused irregularly with light brown and gray, the costa with small black spots and striae; subterminal black lunules, merely punctiform at tornus; terminal dark shading from apex to vein 4. Hind wing hair brown, the base with pale suffusions, the cilia white. Fore wing below mostly grayish olive, the costa, termen and inner margin white, a terminal black line, also the veins terminally black; cilia cinnamon at apex. Hind wing below white, the costa and termen grayish olive, more diffused than on fore wing.

Expanse, 44 mm.

Habitat.—Santa Catharina, Brazil.

Type.—U.S.N.M. no. 34710.

Two paratypes in collection.

Genus KURTIA Schaus

KURTIA DELOSIA, new species

Male.—Head fuscous with a white patch in front of antenna; palpus black above, underneath white; front of collar fuscous; thorax and patagia mottled avellaneous and fuscous; abdomen above dark drab, underneath light grayish vinaceous with transverse drab bands. Fore

wing buffy olive, somewhat glossy, the costa broadly pale ochraceous-salmon; a dark spot at base of costa. Hind wing dark olive-buff, somewhat metallic, with faint whitish suffusions at base. Fore wing below paler than above, strongly metallic, the costa slightly vinaceous. Hind wing below glossy white with faint darker suffusions.

Expanse, 48 mm.

Habitat.—Hansa Humboldt, Brazil.

Type.—U.S.N.M. no. 34721.

Genus HEMICERAS Guénée

HEMICERAS TRISTANA, new species

Male.—Palpi chamois, the upper edge tawny; vertex gray with a few dark scales; collar in front and patagia light grayish vinaceous, the latter dorsally edged with fuscous, also the thorax; abdomen dorsally drab, sublaterally and underneath cameo pink. Fore wing honey yellow, silky and with a faint roseate tinge with dark irrorations forming lines; at base a costal spot to median vein; an antemedial shade slightly outcurved from subcostal to inner margin followed by black points on subcostal, median and below median; some dark shading medially above inner margin; a small black spot in cell at subcostal; an oval narrow black spot on discocellular; a black point at base of vein 5 closely followed by a larger black spot; a pale postmedial line from costa to vein 2, then slightly incurved, its proximal edge with black points on veins and with darker shading distally at inner margin; termen with irregular dark shading. Hind wing whitish with honey-yellow suffusions, dark at anal angle. Fore wing below light pinkish cinnamon, the hind wing white.

Female.—The wings distinctly darker, the suffusions broader, almost dark vinaceous-drab; a fine pale outcurved antemedial line.

Expanse.—Male 44 mm.; female 47 mm.

Habitat.—Santa Catharina, Brazil.

Type.—U.S.N.M. no. 34726.

Allied to *Hemiceras latior* Draudt and *H. punctata* Dognin, differing in the three discal spots on fore wing. Five males and two females in collection.

HEMICERAS ROSTERIA, new species

Male.—Head and body above cinnamon-buff, abdomen laterally and underneath pinkish buff. Fore wing antimony yellow, somewhat darker on inner margin; the lines fine, darker, the antemedial, vertical, pale edged proximally, the postmedial from costa at two-thirds from base, inbent to inner margin near antemedial, pale edge distally; a subterminal line more indistinct; a faint streak on discocellular, the inner margin lobed at middle. Hind wing white suffused with pale

yellow-orange; stigma small, the color of fore wing. Wings below pale ochraceous-salmon, the fore wing with traces of antemedial and postmedial lines, the cilia finely dark red.

Female.—Fore wing somewhat darker than in the male, the subterminal line better defined and distally pale edged.

Expanse.—Male 32 mm.; female 44 mm.

Type.—U.S.N.M. no. 34727.

Habitat.—Aroa, Venezuela.

Allied to *Hemiceras ruizi* Dognin. Three males and four females in collection.

Family BOMBYCIDAE

Subfamily EPIINAE

Genus QUENTALIA Schaus

QUENTALIA CAMELOI, new species

Female.—Head, collar, and thorax aniline black; abdomen vinaceous slate. Fore wing deep heliotrope-gray, the markings aniline black; a streak on base of costa; a basal patch below cell; an angled faint medial line; the end of cell and slightly beyond connecting with a postmedial angled line; the termen narrowly, and a subterminal line from apex pale vinaceous-drab. Hind wing vinaceous-slate; a faint paler subterminal line; on inner margin three small black spots separated by pale grayish vinaceous scaling. Wings below dark heliotrope-gray. Fore wing with termen below apex narrowly dark slate-violet not reaching tornus, proximally edged by a pale ecru-drab line; dark suffusions at base; inner margin ochraceous-buff. Hind wing below with a thick darker medial line and a fine streak on discocellular; a subterminal dark lunular line distally edged with some paler scales.

Expanse, 34 mm.

Habitat.—Tuxtepec, Oaxaca, Mexico.

Type.—U.S.N.M. no. 34701.

Collected by Joaquin Camelo.

Subfamily ZANOLINAE

Genus APATELODES Packard

APATELODES MERLONA, new species

Male.—Head, collar, and patagia light russet-vinaceous; a small dorsal black spot on collar, thorax posteriorly black, probably the same under patagia; abdomen somewhat darker with fine dark transverse lines, the anal segment above fuscous. Fore wing light russet-vinaceous, the termen partly and tornal space with dark vinaceous-drab suffusions forming broad upright lines; subbasal, antemedial, medial, and postmedial black points on costa with faint, darker,

sinuous lines, the medial line double, the postmedial line outcurved, then punctiform; a velvety-black outcurved spot on inner margin beyond base followed by a fine upright black line. Hind wing above mostly light cinnamon-drab, the costa whitish, the veins finely dark; a somewhat paler medial shade; a postmedial black spot on inner margin, edged below with white. Fore wing below vinaceous-fawn, the costal margin white to near apex, the postmedial line broad, darker, faintly curved at costa then vertical; a fine dark angled line on costa before apex; termen dark vinaceous-purple narrowing to tornus. Hind wing below with basal half of costa broadly light grayish vinaceous, a pale vinaceous large triangular spot on inner margin broadly edged above and below with dark vinaceous-drab; a short dark medial line from costa; an outcurved postmedial white line with some pale vinaceous scaling above it at inner margin; termen mostly vinaceous-drab.

Expanse, 52 mm.

Habitat.—Cheyel, Guatemala.

Type.—U.S.N.M. no. 34698.

APATELODES FLORISA, new species

Female.—Head, collar, and thorax light vinaceous-gray with a medial fuscous line; abdomen light vinaceous-drab, with fuscous dorsal tufts and lateral fuscous segmental lines, underneath purplish vinaceous. Fore wing largely light grayish vinaceous; some light brownish vinaceous scaling followed on inner margin by a dark vinaceous upright oblique spot on one wing, on the other formed by a series of short upright lines; a double outcurved dark line from costa, united below cell, downbent double, lunular on inner margin; a faint whitish line at end of cell; a dark postmedial line outbent from costa, then lunular dentate, indistinct, followed by a parallel line with black points on veins; a broken black triangular line on costa before apex distally edged with white; termen partly shaded with fuscous from vein 5 to near tornus on one wing, on the other the shading is absent. Hind wing cinnamon-buff, darker on termen; faint medial and postmedial lines; inner margin with dark scaling, an angled white line above anal angle. Fore wing below cinnamon-pink, the inner margin whitish; a triangular white spot on costa before apex; termen from apex to vein 2 hessian brown. Hind wing below cinnamon-buff; inner margin white from base to medial line which is slightly excurved below vein 3; postmedial line fine, white, proximally edged by a black line. The apex of fore wing acute, the termen rounded.

Expanse, 35 mm.

Habitat.—Tucuman, Argentina.

Type.—U.S.N.M. no. 34696.

APATELODES VISTANA, new species

Female.—Vertex light grayish vinaceous; collar and thorax cinnamon-buff, the former with a small dorsal black spot, the latter posteriorly black connected with a basal black band on abdomen, which is slightly darker than the thorax. Fore wing with the base and anteriorly light pinkish cinnamon; an antemedial fine dark line, basally pale edged outwardly curved from costa, preceded on inner margin by a large, almost quadrate velvety-black spot nearly reaching cell; medial, postmedial, and subterminal fine outcurved lines; the tornal area to vein 3 from medial line to termen suffused with mikado brown, also along termen to apex inwardly limited by a pale roseate line from costa. Apex of wing produced, the termen excurved below it. Hind wing pecan brown, the costal margin more roseate; a dark antemedial curved line and a pale postmedial line; a livid pink streak on inner margin cut by a small black spot. Fore wing below vinaceous-fawn the costal margin white to near apex; the lines faint except the distinct postmedial line; a subterminal fine white line from costa, faintly indicated from vein 4 to inner margin; termen dark vinaceous-purple except at tornus. Hind wing below somewhat darker except the broad roseate costal region; a short dark line at cell, a distinct dark medial line, and a fine whitish subterminal line more deeply curved; termen at anal angle dark vinaceous-purple; the pale line on inner margin as above.

Expanse, 73 mm.

Habitat.—Buena Vista, Colombia.

Type.—U.S.N.M. no. 34697.

APATELODES DAMORA, new species

Male.—Head and collar pale congo pink; patagia white, irrorated with grayish-vinaceous hairs; thorax concealed by patagia. Abdomen above with white hairs at base, then roseate followed by white segments all crossed by black segmental lines; anal hairs partly cinnamon-drab; underneath roseate. Fore wing base with costa white, followed by gray and black scaling in base of cell, a light russet-vinaceous antemedial space from below costa to inner margin followed by white scaling in cell; a medial cinnamon-drab fascia, broad on costa, constricted to a line from cell to below vein 2, expanding on inner margin, the whole limited by a sinuous drab line; terminal third lilacine white; a postmedial fine dark lunular line; traces of a subterminal from costa to vein 3; a small russet-vinaceous spot on costa before apex with a small white spot. Hind wing cinnamon-buff without lines; costa whitish; inner margin whitish with two small dark spots. Fore wing below whitish faintly suffused with pinkish buff; a faint postmedial line; a triangular terminal russet-vinaceous patch from apex to vein 3;

a small hyaline spot above vein 6. Hind wing below with basal half as on fore wing, the termen broadly brownish vinaceous; medial dark points on costa and discocellular; two similar points before the white inner margin; a fine dark curved postmedial line.

Expanse, 40 mm.

Habitat.—Hansa Humboldt, Brazil.

Type.—U.S.N.M. no. 34700.

APATELODES EROTINA, new species

Male.—Head avellaneous with a small black spot; collar and patagia drab-gray, the collar anteriorly dark brown, the patagia dorsally with some black hairs and medially crossed by a black line; thorax posteriorly fuscous. Abdomen dorsally hair brown, laterally with pale segmental lines. Fore wing drab-gray mottled with ecru-drab, the lines very fine, dark; the antemedial outbent to vein 2 then sinuous and downbent, the medial line slightly outcurved and downbent, touching the antemedial at vein 2, both lines then diverging to inner margin; the cell crossed at discocellular by a whitish line, followed by an outcurved line from costa; postmedial line more prominent and darker, more sinuous from vein 4 to inner margin; subterminal line white from costa expanding into a small white spot at vein 5, then faintly indicated; a dark curved shade from below angle of cell to tornus; a curved fuscous spot on inner margin antemedially; apex acute, termen rounded. Hind wing avellaneous, paler on costa; faint darker medial and postmedial lines; anal angle fuscous, and a small black spot above it on inner margin. Fore wing below from base for two-thirds pale salmon color; costa finely whitish; terminal third avellaneous, the apex narrowly fuscous; a subterminal dark straight line from costa to tornus. Hind wing below with the large pale grayish-vinaceous spot on inner margin acute toward base touching a similar broad shade on basal half of costal margin, the spot outwardly edged with mikado brown; a postmedial curved line from costa to inner margin just above the anal angle, this line fine, dark, distally edged with white, proximally broadly army brown from costa to vein 5; termen broadly light russet-vinaceous and cinnamon-drab; anal angle edged with dark purple-drab.

Expanse, 42 mm.

Habitat.—Erotina, Costa Rica.

Type.—U.S.N.M. no. 34699.

Genus THELOSIA Schaus

THELOSIA MAYACA, new species

Male.—Head, collar, and thorax drab; abdomen light pinkish cinnamon. Fore wing ochraceous-buff, the termen broadly suffused

with roseate, the costa sorghum brown, the inner margin whitish not reaching tornus; faint subbasal, antemedial, and medial darker lines, all irregular; a fuscous point in cell; postmedial almost vertical, broad, buckthorn brown; an irregular subterminal line, punctiform, at inner margin lunular; a submarginal deeply lunular line, hair brown; cilia dark tipped with white. Hind wing tawny-olive, darker on termen; a faint darker medial line. Fore wing below purplish drab, the costa and termen warm buff; a postmedial dark line, almost vertical; the submarginal line of upper side indicated; a dark terminal line. Hind wing below warm buff with some dark irrorations, a black point on cell; medial line downbent from costa, at cell inbent to middle of inner margin; traces of a subterminal line; cilia white with dark points at tips of veins.

Expanse, 37 mm.

Habitat.—Pumayaca, Peru.

Type.—U.S.N.M. no. 34694.

THELOSIA HERTA, new species

Male.—Closely allied to *Thelosia mayaca* Schaus, differing in the following respect: Abdomen below white. Fore wing more of a salmon-buff; the medial line more distinct; postmedial line finer, nearer termen; subterminal line distinct, lunular; marginal line also lunular; hind wing darker, no medial line. Wings below light ochraceous-buff, the fore wing with a point in cell, the postmedial line very fine, faintly sinuous approximated by the distinct subterminal line; submarginal line sinuous. Hind wing below with the medial line faint, lunular dentate, as also the subterminal line.

Expanse, 23 mm.

Habitat.—Villa Rica, Paraguay.

Type.—U.S.N.M. no. 34695.

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RESTRICTION OF THE GENUS GELECHIA (LEPIDOPTERA: GELECHIIDAE), WITH DESCRIPTIONS OF NEW GENERA

By AUGUST BUSCK

THE GENUS *Gelechia* Hübner,[1] type *G. rhombella* (Schiffermüller), has become, in the course of years since its erection, a "wastebasket"[2] for hundreds of heterogeneous species of gelechiids that could not readily be assigned to other genera on wing or palpal characters. The result is an aggregation of more than 400 such species under the gereric name *Gelechia*. Quite aside from the inconvenience of such an unwieldy number of species in one genus, it is apparent that this lumping does not represent a natural grouping, but that many of the included species are less related to their associates in the check lists under that genus than they are to the species placed in other genera. *Gnorimoschema* Busck (*Phthorimaea* Meyrick), for example, which has been correctly separated for many years on obvious pterogostic and oral characters, is clearly more closely related to *Gelechia* proper than most of the genera here eliminated from the concept. For this reason it is included in the synoptic tables in this paper, and figures of the genitalia are given for comparison (pl. 58, fig. 2; pl. 65, fig. 36).

Several sound attempts have been made by workers in continental Europe, notably Heinemann,[3] to make a more natural classification by the erection of separate genera for species with certain slight modifications of wing structure and palpal characters in common, but the

[1] Verzeichniss bekannter Schmetterlinge, p. 415, 1816.

[2] As early as 1872 V. T. Chambers commented on "the elastic limits of that accommodating genus *Gelechia*, the microlepidopterists' waste-paper box," Can. Ent., vol. 4, p. 147, 1872.

[3] Schmetterlinge Deutschlands und der Schweiz, 1870.

absence of any striking differences in these characters left, nevertheless, a large residue of species, not closely related, in the genus *Gelechia*, which thereby became difficult to define concisely. Spuler [4] states after his description of the genus: "Die Verschiedenheiten im Bau verlangen eine Aufteilung der Arten in mehrere Genera," and several others have pointed this out. On the other hand, Meyrick [5] discarded even these attempts and lumped 380 species in *Gelechia*.

Of late, new species have been described as "*Gelechia* species" or "*Gelechia*? sp.," [6] and, as many more new species of this group are yet to be described, it is desirable, both for practical and for taxonomic reasons, that the genus, which contains a number of species of economic importance, should be divided into its different natural components.

A study of the genitalia of both sexes reveals characters by which this division can be made, and a more natural arrangement of the numerous species can be effected. A first step toward this was made by Pierce and Metcalfe [7] for the limited British fauna. These authors reduced the number of British species included by Meyrick in *Gelechia* from 31 to 8. The present paper is a further attempt to divide the genus on genitalic characters, but as it deals mainly with the North American and European species, it is to be expected that additional work along the same lines will be required for the species of other faunas. The resurrection on genitalic characters of nearly all the genera proposed in this group by earlier workers, but which have later been discarded and placed as synonyms in Meyrick's revision of the family, is one gratifying result of this study. Besides these it has been found necessary to define seven new genera.

The generic division on genitalic characters does not contradict the characters of venation and mouth parts; on the contrary, the genitalia serve further to support these characters, but it is realized that some of the wing characters are not so stable in this group as hitherto supposed. For example, the close approximation of veins 3 and 4 in the fore wing of *Gelechia*, as now restricted, culminates in some of the species in the stalking of these veins, and this apparently does not justify generic separation. Overemphasis of this character, which recurs in several other genera, led Walsingham [8] to assert that in any division of *Gelechia* the genonym must be restricted to the group having veins 3 and 4 of the fore wings stalked, and on that ground he associated the common American *bosquella*

[4] Die Schmetterlinge Europas, vol. 2, p. 360, 1910.
[5] Genera insectorum, fasc. 184, pp. 74–84, 1925.
[6] Keifer, Monthly Bull. California Dept. Agr., vol. 25, p. 240–242, 1936.
[7] Genitalia of the tineid families of the Lepidoptera of the British Islands, 1935.
[8] Biologia Centrali-Americana, vol. 4, p. 60, 1911.

Chambers with the genotype of *Gelechia*, the European *rhombella; bosquella*, however, differs from *Gelechia* in other venational characters and on the basis of genitalia structures belongs to a quite different group, for which Meyrick has erected the genus *Stegasta*, the type of which is the Indian species *væriana* Meyrick. For comparison the striking genitalia of this genus are figured (pl. 63, figs. 26, 27; pl. 70, figs. 60, 61).

The genus *Bryotropha* Heinemann, sunk by Meyrick as a synonym of *Gelechia*, owing to the supposed lack of stable venational characters to differentiate it, although retained by the continental European workers, proves to be very distinctly defined by the genitalia, as already shown by Pierce and Metcalfe[7], and its validity is further emphasized by the venation and by the single bristle on the basal antennal joint, a character that does not seem to have been recorded before, apparently having been overlooked; it is a remnant of a pecten, which is very significant and unusual in the family Gelechiidae, shared only by very few genera, like *Sitotroga* and *Pectinophora*, from which *Bryotropha* is widely separated on other characters.

In *Aroga*, which was mainly founded on the separation of veins 3 and 4 in the hind wings, it is found that this character varies within closely allied species and even in the sexes of the same species.

Like the generic characters in venation and labial palpi, certain characters of the genitalia are found not to be absolute. Nature does not conform with artificial synoptic tables, and these must be used with discretion and with an intimate knowledge of allied forms as well as of the group under study. Thus the signum of the female bursa is absent in some species that are clearly referable on all other characters to genera where the signum normally is present. This absence in isolated species of a character present in closely related species is as difficult to explain as is the purpose of the character itself, but numerous examples of such absence in widely separated families lead to the opinion that the absence of this character is not necessarily of generic significance and that the exception to the rule does not disprove the rule, as we are able to conceive it. Similarly it is found that characters of the male genitalia, which normally are remarkably constant and dependable in the separation of genera, are found in certain genera to be variable, even within the species. Thus while symmetry and asymmetry of the genitalia are not normally found within the same genus, both occasionally do occur as variations within a single species, as for example in the genus *Chionodes*, which, therefore, must be defined on other more stable genitalic characters.

[7] Genitalia of the tineid families of the Lepidoptera of the British Islands, 1935.

In spite of these and other variations the genitalia are, as is the venation, remarkably constant and offer excellent characters for generic and specific definition as well as for family grouping. The fact that scarcely any two specimens of our common cosmopolitan clothes moth, *Tineola biselliella* (Hummel), have identical venation does not nullify the value of venation, and this species may actually be identified on its venation alone in spite of the variation. Similarly there is very great variation in the harpes of the gelechiid species *Chionodes dentella* (Busck), but the species may nevertheless be definitely identified by the genitalia alone.

No apology is needed for the use of the characters of the genitalia as major determinating factors in the definition of genera. Their value in the sound classification of Lepidoptera is conceded by all modern workers. The time has passed when the dissection of these parts of the males was deplored and consolation found in the belief that "this new science will not classify the females, so it is a pleasant reflection in these days of equal suffrage to know that the females will still look forward" while "it may be necessary some day to turn our males around in our collections and let them travel backwards."[1]

Too little is known as yet about the early stages of this group to warrant generalizations about the larval and pupal characters, but the few species of which these stages have been properly studied and figured, mainly by Heinrich and Keifer, clearly substantiate further the generic divisions made in this paper. The presence or absence of a cremaster in the pupa and the length of the wing covers and antenna of the pupa, for example, appear from the evidence at hand to be constant within the genus; these characters will presumably prove to be of generic value and verify the divisions made in this paper on adult characters.

The present contribution is based on material in the United States National Museum. The figures were drawn under the author's supervision by Mrs. Mary Foley Benson from slides made by the author. The plates were arranged by Mrs. Eleanor A. Carlin. To both thanks are due for their expert help.

The group of genera here considered have the following external and venational characters in common: Antennae shorter than fore wings; second joint of labial palpus thickened with scales, and with rough and normally furrowed tuft beneath; terminal joint nearly as long as or slightly longer than second. Fore wings elongate, more or less pointed; 12 veins; 7 and 8 stalked, 7 to costa, 6 sometimes out of 7 near base, 3 and 4 approximate, connate or short-stalked, 1b furcate at base, 1c absent. Hind wings nearly as broad as or broader

[1] A. F. Braun, Ent. News, vol. 32, p. 118, 1921.

than fore wings, trapezoidal; apex pointed or obtuse; termen more or less sinuate; 8 veins; 3 and 4 closely approximate, connate or short-stalked; 5 nearer 4 than 6 at base; 6 and 7 approximate at base or connate, or stalked. Hind tibiae rough haired above.

GENERA DEFINED IN THIS PAPER

1. *Gelechia* Hübner; type, *rhombella* (Schiffermüller). Synonym, *Oeseis* Chambers; type, *bianulella* (Chambers).
2. *Gnorimoschema* Busck; type, *gallaesolidaginis* (Riley). New synonym, *Phthorimaea* Meyrick; type, *operculella* (Zeller).
3. *Keiferia*, new genus; type, *lycopersicella* (Busck).
4. *Lita* Treitschke; type, *longicornis* (Curtis).
5. *Friseria*, new genus; type, *lindenella* (Busck).
6. *Chionodes* Hübner; type, *lugubrella* (Fabricius).
7. *Filatima*, new genus; type, *serotinella* (Busck).
8. *Bryotropha* Heinemann; type, *terrella* (Schiffermüller).
9. *Frumenta*, new genus; type, *nundinella* (Zeller).
10. *Aroga* Busck; type, *paraplutella* (Busck).
11. *Pseudochelaria* Dietz; type, *pennsylvanica* Dietz.
12. *Fascista*, new genus; type, *cercerisella* (Chambers).
13. *Epilechia*, new genus; type, *catalinella* (Busck) (*tehuacana* Busck), new synonymy.
14. *Faculta*, new genus; type, *triangulella* (Busck).

OTHER GENERA FIGURED FOR COMPARISON

1. *Nothris* Hübner; type, *verbascella* (Schiffermüller).
2. *Stegasta* Meyrick; type, *variana* Meyrick.
3. *Evippe* Chambers; type, *prunifoliella* Chambers.
4. *Anacampsis* Curtis; type, *populella* (Clerck).
5. *Recurvaria* Haworth; type, *nanella* (Hübner).
6. *Strobisia* Clemens; type, *iridipennella* Clemens.
7. *Dichomeris* Hübner; type, *ligulella* (Hübner).

SYNOPTIC KEY TO THE GENERA BASED ON MALE GENITALIA

1. Uncus hood-shaped, with apex sometimes indented or bifid 2
 Uncus not hood-shaped 10
2. Base of gnathos soft, pillowlike, minutely spined, with slight terminal sclerotization 3
 Gnathos a strong hook 4
3. Alimentary canal within tegumen supported by two flattened rods **Gelechia**
 Alimentary canal without such support **Gnorimoschema**
4. Uncus very short, edged with row of strong spines 5
 Uncus large 6
5. Aedeagus straight, with stalk below entrance hole for penis **Lita**
 Aedeagus curved, with bulbous base **Friseria**
6. Aedeagus with long stalk below entrance hole for penis **Chionodes**
 Aedeagus without such stalk 7
7. Aedeagus short, stumpy, with lateral branches or spines 8
 Aedeagus long, slender, with bulbous base 9

8. Harpes divided Filatima
 Harpes not divided Epilechia
9. Hook of gnathos pointed Bryotropha
 Hook of gnathos spoon-shaped Frumenta
10. Uncus pointed, smooth 11
 Uncus blunt, spiny Pseudochelaria
11. Gnathos weak or absent 12
 Gnathos strongly developed 13
12. Harpes ending in sharp spine Aroga
 Harpes enlarged at tip Keiferia
13. Harpes divided or furcate at tip Fascista
 Harpes simple Faculta

SYNOPTIC KEY TO THE GENERA BASED ON FEMALE GENITALIA

1. Signum double 2
 Signum single 3
2. Signa two strongly dentate plates Lita
 Signa two large, flattened, smooth-edged plates Epilechia
3. Signum a single thorn or spine 4
 Signum not so 7
4. Signum strongly dentate Filatima albilorella (Zeller)
 Signum not dentate or only slightly so 5
5. Signum a sharp-edged, compressed thorn from a flattened base Fascista
 Signum not so 6
6. Signum long, curved, sharply pointed Keiferia
 Gnorimoschema
 Signum straight, obtusely pointed Frumenta
7. Signum an involuted, double-flanged, spiny plate 8
 Signum not so 10
8. Signum large, angular, with minute spines 9
 Signum small, oval, with dentate edges Chionodes
9. Ostial plate with lateral lobes Gelechia
 Ostial plate without lateral lobes Pseudochelaria
10. Upper part of bursa spined 11
 Bursal wall not spined 13
11. Ductus bursae short, straight 12
 Ductus bursae long, twisted upon itself Friseria
12. Signum with four long arms Faculta
 Signum not so Filatima
 except *F. albilorella* (Zeller)
13. Signum a small rectangular plate with a strong spine at each corner Aroga
 Signum a spiny plate with two transverse raised keels Bryotropha

1. Genus GELECHIA Hübner

PLATE 58, FIGURE 1; PLATE 61, FIGURE 19; PLATE 65, FIGURE 34

Gelechia HÜBNER, Verzeichniss bekannter Schmetterlinge, p. 415, 1816. (Genotype, *Tinea rhombella* Schiffermüller.)

Cirrha CHAMBERS, Can. Ent., vol. 4, p. 146, 1892. (Genotype, *Depressaria albisparsella* Chambers.)

Oeseis CHAMBERS, Cincinnati Quart. Journ. Sci., vol. 2, p. 255, 1875. (Genotype, *Oeseis bianulella* Chambers.)

Fore wings with veins 3 and 4 closely approximate, connate or stalked. Hind wings broader than fore wings. Veins 6 and 7 closely approximate or more often stalked.

Male genitalia with uncus reduced as a soft, hoodlike upper edging of tegumen with few short, nearly equidistant spines. Gnathos a soft, minutely spined pillow [10] terminating in a small, weakly chitinized, often 3-forked hook. Socii absent. Alimentary canal supported by two large flattened rods within tegumen. Upper branch of harpe long, often flattened, spindle-shaped, pointed, hairy at tip; lower branch of harpe shorter, often abruptly bent forward on middle. Aedeagus specialized, pointed, scobinate at tip and normally with a short branch. Vinculum strong, with flattened process. Eighth segment developed into a cover for the genitalia; dorsal half largest and with two thin, curved hair tufts from near base.

Female genitalia with short lateral lobes on genital plates; signum quadrangular with the two opposite edges bent upward and inward to form a pocket, normally heavily covered with short spines; rarely signum absent (*rhombella*).

The American *Oeseis bianulella* Chambers was mistakenly made a synonym of the European *sabinella* Zeller by Meyrick and placed in the genus *Nothris;* the two species are congeneric but quite distinct specifically and do not belong to *Nothris* Hübner, which has a different type of genitalia (pl. 63, fig. 25, and pl. 71, fig. 63). Both species fall in *Gelechia* as here defined; if a separation seems necessary, of the species that are here placed in *Gelechia* but which have the brush on the second joint of the labial palpi longer and pointed, approaching that of *Dichomeris*, the generic name *Oeseis* Chambers may be utilized. The character does not appear to be of generic importance in this group, however, because all the intergrades between the evenly short-furrowed brush to the longer brush with uneven length of scales are found in otherwise closely similar species.

[10] Pierce and Metcalfe (*op. cit.*) consider this the anus, but the alimentary canal opens behind it, between it and the uncus, and from comparison with the similar structure in *Gnorimoschema* I believe it to be associated with the gnathos. The assignment of name may be debatable; but whatever the designation, the structure is very striking and an excellent character in the definition of the two genera possessing it.

NORTH AMERICAN SPECIES OF GELECHIA

bianulella (Chambers). Synonyms: *ocellella* Chambers, *sabinella* Meyrick (*nec* Zeller).
anarsiella Chambers.
monella Busck.
panella Busck.
dyariella Busck.
rileyella (Chambers).
albisparsella (Chambers). Synonym: *platanella* (Chambers).
versutella Zeller.
mandella Busck.
lynceella Zeller.
caudata Clarke.
trilineella Chambers.
desiliens Meyrick.
dromicella Busck.
obscurosuffusella Chambers. Synonym: *canopulvella* Chambers.
ribesella Chambers.
benitella Barnes and Busck.

EUROPEAN SPECIES OF GELECHIA

rhombella (Schiffermüller).
muscosella Zeller.
hippophaella Zeller.
rhombelliformis Staudinger.
sororealella Hübner.
nigra Haworth.
pinguinella Treitschke.
scotinella Herrich-Schaeffer.
cuneatella Duponchel.
obscuripennis Frey.
sabinella Zeller.
asinella Zeller.

Undoubtedly others belong here, but several intervening species in the European check lists do not belong to *Gelechia* as here restricted.

2. Genus GNORIMOSCHEMA Busck

PLATE 58, FIGURE 2; PLATE 65, FIGURE 36

Gnorimoschema BUSCK, Proc. U. S. Nat. Mus., vol. 23, p. 227, 1900. (Genotype, *Gelechia gallaesolidaginis* Riley.)
Phthorimaea MEYRICK, Ent. Mon. Mag., vol. 38, p. 103, 1902. (Genotype, *Gelechia operculella* Zeller.)

Third joint of labial palpus more or less thickened with scales normally protruding beyond the apex. Fore wings with veins 2, 3, 4, 5, and 6 nearly equidistant. Hind wings with veins 6 and 7 parallel or nearly so; veins 3 and 4 connate or stalked; 5 approximate to 4.

Male genitalia with uncus short, hood-shaped, often bluntly pointed; gnathos with large, soft, pillowlike, spiny base terminating in slightly curved, tongue-shaped, sclerotized hook, sometimes 3-forked. Upper arms of harpes long, slender, normally bent forward; lower branches of harpes shorter, hairy at tip. Aedeagus nearly straight, somewhat enlarged at base, with entrance hole for penis lateral. Vinculum strong, with broad, flattened, anterior process. Eighth segment large, dorsal half largest and normally with two thin hair tufts from near base.

Female genitalia with upper part of ductus more or less sclerotized; posterior apophyses stout, pointed, fused with a strongly sclerotized, large genital plate; bursa large, oblong; signum a single, curved, sharply pointed, sometimes slightly dentate thorn with bulbous base extending outside the wall of bursa.

AMERICAN SPECIES OF GNORIMOSCHEMA

gallaesolidaginis (Riley).
gallaeasteriella (Kellicott). Synonyms: *caesiella* (Brodie), *gallaediplopappi* (Fyles).
salinaris Busck.
subterranea Busck.
charcoti (Meyrick).
gibsoniella Busck.
septentrionella (Fyles).
alaricella Busck.
semirosea Meyrick.
*buscki*ella Kearfott.
eucausta Meyrick.
laguna Busck.
lipatiella Busck.
placesiosema (Turner), described from Australia. New synonyms; *melanoplintha* (Meyrick), described from New Zealand; *tuberosella* Busck, described from Peru.
consucta Braun.
tetradymiella Busck.
miscitatella Clarke.
chenopodiella Busck.
polemoniella (Braun).
axenopis (Meyrick). Synonym: *artimisiella* Kearfott.
erigeronella Braun.
batanella Busck.
ochroschista (Meyrick).
chiquitella Busck.
sacculicola (Braun).
macromaculata Braun.
lavernella (Chambers). Synonym: *physalivorella* (Chambers).
henshawiella Busck. Synonym: *ochreostrigella* (Chambers).
potentella Keifer.
grisella (Chambers). Synonym: *discomaculella* (Chambers).
operculella (Zeller). Synonyms: *solanella* (Boisduval), *tabacella* (Ragonot).
minor Busck.
gudmannella (Walsingham).
brackenridgiella Busck. Synonym: *detersella* (Clemens).
scutellariacella (Chambers).
ambrosiaeella (Chambers).
pallidochrella (Chambers).
versicolorella (Chambers).
albimarginella (Chambers).
serratipalpella (Chambers).
contraria Braun.
lutescella Clarke.
banksiella Busck.
washingtoniella Busck.
triocellella (Chambers).
albangulata Braun.
octomaculella (Chambers).
semicyclionella Busck.
florella Busck.
vastifica Braun.
baccharisella Busck.
coquillettella Busck.
cricameriae Keifer.
dudiella Busck.
saphirinella (Chambers).
splendoriferella Busck.
princeps Busck.
radiatella Busck.
striatella (Murtfeldt).
sporomochla Meyrick.
compsomorpha Meyrick.
millericlla (Chambers).
emancipata (Meyrick). Synonym: *marmorella* (Chambers).
incxperta (Meyrick). Synonym: *simpliciella* (Chambers).
terracottella Busck.
faustella Busck.
collinusella (Chambers).
atriplex Busck.
petrella Busck.
neopetrella Keifer.
lectulifera Meyrick.
fercularia Meyrick.

3. KEIFERIA, new genus

PLATE 58, FIGURE 3; PLATE 61, FIGURE 18; PLATE 65, FIGURE 35

Closely allied to *Gnorimoschema* and with the same palpal and wing characters but differing strikingly in the form of the uncus.

Labial palpus with brush on second joint slightly furrowed, terminal joint slightly thicknened with scales, which protrude beyond the tip.

Fore wings with 12 veins, veins 2 to 6 nearly equidistant. Hind wings with 8 veins, 3 and 4 connate or short-stalked, 5 approximate to 4; 6 and 7 nearly parallel.

Male genitalia with upper branch of harpe slender, broadened at tip, often furcate at tip; lower branch or harpe short; uncus a large hook, pointed; gnathos weak or undeveloped; vinculum broad and long; aedeagus slender, curved, with bulbous base and hooked apex. Female genitalia with upper part of ductus bursae sclerotized; bursa large, oblong, with a single strong, sometimes slightly dentate, thorn-like, strongly curved signum, the base of which extends outside the bursa wall.

Named in honor of H. H. Keifer, assistant entomologist of the California Department of Agriculture, who has done much careful biological work with this group of economically important species.

Genotype, *Gnorimoschema lycopersicella* Busck.[11]

NORTH AMERICAN SPECIES OF KEIFERIA

lycopersicella (Busck).
glochinella (Zeller). Synonyms: *solaniella* (Chambers), *cinerella* (Murtfeldt), *inconspicuella* (Murtfeldt).
elmorei (Keifer).
altisolani (Keifer).

All these names are transferred from *Gnorimoschema*.

4. Genus LITA Treitschke

PLATE 58, FIGURE 5; PLATE 65, FIGURES 37–39

Lita TREITSCHKE, Die Schmetterlinge Europas, vol. 9, p. 76, 1833. (Genotype, *Lita zebrella* Treitschke, synonym of *Anacampsis longicornis* Curtis.)

Labial palpus with second joint very long, slender; brush short and hardly furrowed; terminal joint long, slender, acute.

Fore wing with vein 2 distant from 3. Hind wing with veins 6 and 7 separate at base, nearly parallel; veins 3 and 4 approximate, connate or stalked.

Male genitalia with uncus very short, broad, edged with strong, flattened spines; gnathos a strong curved hook; upper branch of harpe long, curved, club-shaped; lower branch shorter, serrated on edge; aedeagus straight, with stalk below entrance hole for penis; eighth segment moderate.

Female genitalia with signa two strong dentate plates.

[11] Proc. Hawaiian Ent. Soc., vol. 7, p. 171, 1928.

Two of the described American species of the genus, *Lita puertella* (Busck) and *Lita invariabilis* (Kearfott), have a peculiar, sharply toothed, strongly sclerotized process on the front of the head, protruding beyond the scales (pl. 65, figs. 38, 39), undoubtedly corresponding to a similar prominence on the pupa, which assists the latter in cutting its way out through a tough surface, such as the stalk of a dry desert plant. It is a specific character only, the other species of the genus having normal flat or evenly rounded faces.

AMERICAN SPECIES OF LITA

longicornis (Curtis). Synonyms: *alternatella* (Kearfott), *alpicola* (Frey), *petulans* Braun.
barnesiella (Busck).
variabilis (Busck).
invariabilis (Kearfott).
puertella (Busck).
diversella (Busck).
rectistrigella (Busck).
texanella (Chambers). Synonym: *chambersella* (Dyar).
prorepta (Meyrick). Synonym: *fulmenella* (Busck), preoccupied.

The names listed above have been cataloged under *Gelechia* in North American literature.

EUROPEAN SPECIES OF LITA

longicornis (Curtis).
solutella (Zeller).
[Probably others.]

5. FRISERIA, new genus

PLATE 58, FIGURE 4; PLATE 67, FIGURE 46

Labial palpus with brush on second joint small; terminal joint longer than second, smooth, pointed.

Fore wings with veins 3, 4, and 5 equidistant; veins 2 and 6 farther separated. Hind wings as broad as fore wings; veins 3 and 4 closely approximate but separate; 6 and 7 connate.

Male genitalia with uncus very short, hood-shaped, edged with stiff spines; gnathos a strong slender hook; harpes divided into three arms; vinculum broad; aedeagus slender, curved, with large bulbous base.

Female genitalia with long ductus bursae, closely spiraled upon itself; signum a large rectangular plate with two sinuate arms, or with spines in the four corners.

Genotype, *Gelechia lindenella* Busck.[12]

AMERICAN SPECIES OF FRISERIA

lindenella (Busck).
malindella (Busck).
repentina (Walsingham).
cockerelli (Busck).
fuscotaeniella (Chambers).
sarcochlora (Meyrick).

All these species were described in the genus *Gelechia*.

[12] Proc. U. S. Nat. Mus., vol. 25, p. 876, 1903.

6. Genus CHIONODES Hübner

PLATE 59, FIGURES 6–9; PLATE 66, FIGURES 40–43

Chionodes HÜBNER, Verzeichniss bekannter Schmetterlinge, p. 420, 1816. (Genotype, *Chionodes luctificella* Hübner, synonym of *Tinea lugubrella* Fabricius.)

Second joint of labial palpus with slightly furrowed brush beneath; terminal joint smooth, pointed.

Fore wings with veins 2 to 6 equidistant. Hind wings with veins 3 and 4 connate or short-stalked; 6 and 7 closely approximate, connate or stalked.

Male genitalia with uncus large, hood-shaped, sometimes divided at apex; gnathos a strong curved hook; harpes very variable, even within the species, and often asymmetrical, upper arm normally long, slender, somewhat enlarged and commonly bifurcate at tip, but sometimes, within the same species, reduced, asymmetrical, with the right harpe much shorter than the left, and sometimes (the genotype) rudimentary; lower arms short, stumpy, spiny at apices; aedeagus elongate, with long slender stalk below entrance hole for penis, apex with strongly modified lateral projections. Eighth segment developed into large enveloping upper and lower sheaths.

Female genitalia with upper part of walls of ductus granulated, bursa large, with upper part of wall spined; signum oval, dentate with stronger teeth along its edges.

In spite of the diversity of forms and the individual variations in the genitalia, they conform to a general, easily perceived pattern, and the genus, as restricted, constitutes a natural group, which should not be further subdivided.

AMERICAN SPECIES OF CHIONODES

lugubrella (Fabricius). Synonym: *luctificella* Hübner.
viduella (Fabricius). Synonym: *labradoriella* (Clemens).
continuella (Zeller). Synonyms: *trimaculella* (Packard), *albomaculella* (Chambers).
periculella (Busck).
maculimarginella (Chambers).
seculaella (Clarke).
arcnella (Forbes).
nigrimaculella (Busck).
coticola (Busck). New synonym: *notochlora* (Meyrick).
chloroschema (Meyrick).
fructuaria (Braun).
figurella (Busck).
fondella (Busck).
pseudofondella (Busck).
aristella (Busck).
abdominella (Busck).
sistrella (Busck).
dentella (Busck).
xanthophilella (Barnes and Busck).
pinguicula (Meyrick).
retiniella (Barnes and Busck). New synonym: *langei* (Kelfer).
luteogeminata (Clarke).
mediofuscella (Clemens). Synonyms: *vagella* (Walker), *liturosella* (Zeller), *rhedaria* (Meyrick), *fuscoochrella* (Chambers).
acrina (Kelfer).
trophella (Busck).
abella (Busck).
kincaidella (Busck).
fluvialella (Busck).
psiloptera (Barnes and Busck).

ceanothiella (Busck). New synonym: *marinensis* (Keifer).
nanodella (Busck).
trachycosma (Meyrick).
lophosella (Busck). Synonym: *lophella* (Meyrick).
ochreostrigella (Chambers).
notandella (Busck).
bicostomaculella (Chambers). Synonyms: *gibbosella* (Chambers), *quercifoliella* (Chambers).
vernella (Murtfeldt).
braunella (Keifer). Synonym: *arborei* (Keifer).
occidentella (Chambers).
terminimaculella (Kearfott).
negundella (Heinrich).
dammersi (Keifer).
helicosticta (Meyrick).
paralogella (Busck).
thoracealbella (Chambers).
caryaevorella (Packard).
metallica (Braun).
argentipunctella (Ely).
discoocellella (Chambers). Synonym: *violaceofusca* (Zeller).
hibiscella (Busck).
trichostola (Meyrick).
vanduzeei (Keifer).
chrysopyla (Keifer).
leucocephala (Walsingham), St. Croix, West Indies.

All above names have been cataloged in American literature under *Gelechia*.

7. FILATIMA, new genus

PLATE 60, FIGURES 11–13; PLATE 66, FIGURE 44; PLATE 67, FIGURES 47, 48

Labial palpus with well-developed, dense, furrowed brush on second joint; terminal joint slender, pointed, nearly or fully as long as second.

Fore wings with veins 3, 4, and 5 somewhat approximate, veins 2 and 6 farther separated. Hind wings with 3 and 4 connate, 6 and 7 approximate; in the males with more or less elaborate sex scaling on the underside ("curtain-fringed").

Male genitalia with uncus moderate, hood-shaped. Gnathos a rather short, robust, blunt hook, often sawtoothed on inner edge; harpe with upper and lower branches solidly united at bases, upper branch long, slender, lower branch shorter, robust, pointed, often sawtoothed and porrect. Vinculum large, rounded. Aedeagus short, robust, with sharp lateral projections; upper and lower parts of eighth segment large, rounded, enveloping the genitalia.

Female genitalia with ductus bursae very short and wide, inner wall covered with short spines, bursa double, with signum in the larger half consisting of two strong dentate thorns from a common base (in *F. albilorella* Zeller only one such thorn); signum sometimes absent.

Genotype, *Gelechia serotinella* Busck.[18]

AMERICAN SPECIES OF FILATIMA

serotinella (Busck).
pseudoacaciella (Chambers). Synonym: *caecella* (Zeller).
persicaecella (Murtfeldt). Synonym: *confusella* (Chambers).
amorphaecella (Chambers).
ornatifimbriella (Clemens). Synonym: *unctulella* (Zeller).
abradescens (Braun).
abactella (Clarke).

[18] Proc. U. S. Nat. Mus., vol. 25, p. 882, 1903.

monopa (Meyrick).
auleae (Clarke).
pravinominella (Chambers. Synonym: *quadrimaculella* (Chambers).
normifera (Meyrick).
xanthuris (Meyrick).
lepidotae (Clarke).
demissae (Keifer).
saliciphaga (Keifer).
monotaeniella (Bottimer).
striatella (Busck).
ochreosuffusella (Chambers). Synonym: *depressostrigella* (Chambers).
rivulata (Meyrick).
isocrossa (Meyrick).
gomphopis (Meyrick).
inquilinella (Busck).
bigella (Busck). New synonym: *spilosella* (Barnes and Busck).
neotrophella (Heinrich).
natalis (Heinrich).
albilorella (Zeller). Synonym: *trifasciella* (Chambers).
fulginea (Meyrick).
bimaculella (Chambers). Synonyms: *sylvaecolella* (Chambers), *ternariella* (Zeller).
arizonella (Busck).
clarkella Busck, new name for *albifemorella* (Clarke) preoccupied by *G. albifemorella* Hoffman.
biforella (Busck).
gilvomaculella (Clemens). Synonym: *biminimaculella* (Chambers).
minimaculella (Chambers).
pulliflmbriella (Clemens).
obscuroocellella (Chambers).
depuratella (Busck).
promonitrix (Meyrick).
hemicrossa (Meyrick).
catacrossa (Meyrick).

All the above species are transferred to this genus from *Gelechia*.

8. Genus BRYOTROPHA Heinemann

PLATE 60, FIGURE 10; PLATE 67, FIGURE 45

Bryotropha HEINEMANN, Schmetterlinge Deutschlands und der Schweiz, vol. 2, p. 233, 1870. (Genotype, *Tinea terrella* Schiffermüller.)

Basal joint of antenna with a single bristle (remnant of pecten). Labial palpus with well-developed, furrowed brush on under side of second joint; terminal joint as long as or longer than second, smooth, acutely pointed.

Fore wing with veins 2 to 6 nearly equidistant, subparallel; 7 and 8 stalked. Hind wing with apex produced; veins 6 and 7 stalked; veins 3 and 4 connate or short-stalked.

Male genitalia with uncus large, hood-shaped; socii small but distinctly developed, with a few long bristles; gnathos very large, bulbous, terminating in a strong curved hook. Posterior branches of the harpes small with spiny apices; anterior branches larger, spiny, sometimes with a short branch from near base. Aedeagus long, slender, curved, with bulbous base and apex soft, whiplike. Vinculum well developed, with pointed tip.

Female genitalia with ductus bursae of medium length, straight; bursa oval, without spines; signum, in the typical species, two parallel, transverse, heavy ridges connected by and surrounded with scobinations; in some European species a rectangular plate with spines in the corners, approaching the signum in *Aroga;* for the latter group

of species Pierce and Metcalfe [14] suggest that a new genus is required, but the transition from the typical form of signum with the two transverse ridges and surrounding scobinate plate, which by themselves form a rectangle, seems natural, and I include all these species (genus 20 of Pierce and Metcalfe) in *Bryotropha.*

AMERICAN SPECIES OF BRYOTROPHA

branella (Busck).
clandestina (Meyrick).
inaequalis (Busck). New synonyms: *inaequalis* (Walsingham), *anisectis* (Meyrick).

The above names are new transfers from *Gelechia.*

EUROPEAN SPECIES OF BRYOTROPHA

affinis (Douglas).
terrella (Schiffermüller).
desertella (Douglas).
decrepidella (Herrich-Schaeffer).
[And others.]

9. FRUMENTA, new genus

PLATE 60, FIGURE 14; PLATE 68, FIGURE 49

Second joint of labial palpus with well developed, slightly furrowed brush on under side; terminal joint shorter than second, thickened with scales in front, apex acute.

Fore wing with vein 2 well before angle of cell; 3, 4, and 5 equidistant at base, nearly parallel from end of cell; vein 6 approximate to stalk of 7 and 8. Hind wing broader than fore wing, termen but slightly sinuate, apex not produced; veins 3 and 4 short-stalked, vein 5 cubital, but distant from and nearly parallel to 4; 6 and 7 separate.

Male genitalia with large hood-shaped uncus; gnathos a large flattened, spoon-shaped hook; harpes simple, robust, with rounded apex bent downward. Vinculum large with two short, stout, hairy processes posteriorly [15] and with a long slender process anteriorly. Aedeagus slender, nearly straight, with bulbous base.

Female genitalia with ductus bursae moderately long, narrow, slightly twisted; bursa long elliptical; signum a single, straight, robust spine with blunt apex.

In the character of the palpi, scaling, and aedeagus this genus is similar to *Gnorimoschema* and is probably correlated with or derived from it.

Genotype, *Gelechia nundinella* Zeller.[16] This is the only species at present included.

[14] Genitalia of the tineid families of Lepidoptera of the British Islands, 1935.

[15] This part of the genitalia, including the bases of the harpes, is strongly sclerotized and fused, and it is debatable whether the two short posterior processes actually belong to the vinculum or should be considered the lower branches of the harpes; but comparison with other forms in which both branches of the harpes are clearly developed, and in which similar processes are found on the vinculum at the same time, indicates that the present conception is correct.

[16] Verh. zool-bot. Ges. Wien, vol. 23, p. 256, 1873.

10. Genus AROGA Busck

PLATE 61, FIGURES 15–17; PLATE 68, FIGURES 50–52

Aroga BUSCK, Proc. U. S. Nat. Mus., vol. 47, p. 13, 1914. (Genotype, *Gelechia paraplutella* Busck.)

Second joint of labial palpus with slightly furrowed brush on under side; terminal joint slender, acute, nearly as long as second.

Fore wing with veins 2, 3, 4, and 5 nearly equidistant. Hind wing with veins 3 and 4 closely approximate or connate, 6 and 7 separate, 5 cubital.

Male genitalia with uncus a long, slightly bent, pointed hook; gnathos absent; harpe single, long, slender, ending in a sharp point; vinculum with two large, broad, hairy posterior processes.[17] Aedeagus straight or nearly so, with base not bulbous, entrance hole for penis at the base, not lateral. Ventral sclerites of eighth abdominal segment large, elaborately developed with lateral branches, discernible without dissection on the dry pinned specimen.

Female genitalia with signum a nearly square plate with strong, pointed, sometimes serrate spines from the four corners.

The genus was erected in an attempt to clarify *Gelechia* of authors on venational characters, stress being laid on the separate veins 3 and 4 in the genotype; this character, however, is found to be not dependable, even within the species, but the genitalia prove the genus to be valid, embracing a natural group of species with very striking genital characters in common.

AMERICAN SPECIES OF AROGA

paraplutella (Busck).
paulella (Busck).
leucaniella (Busck).
acharnaea (Meyrick).
chlorocrana (Meyrick).
hipposaris (Meyrick).
aristella (Busck).
unifasciella (Busck).
camptogramma (Meyrick).
morenella (Busck).
coloradensis (Busck).
alleriella (Busck).
rigidae (Clarke).
eriogonella (Clarke).
eldorado (Keifer).
monumentella (Chambers).
trialbamaculella (Chambers). Synonym: *epigaeella* (Chambers).

EUROPEAN SPECIES OF AROGA

velocella (Duponchel).
[Probably others.]

All the above names with the exception of *paraplutella* (Busck) are new transfers from *Gelechia*.

[17] These processes could be regarded as the lower branches of the harpes, but from comparison with similar structures in other genera I consider them a part of the vinculum. Compare with footnote under *Frumenta* (p. 577).

11. Genus PSEUDOCHELARIA Dietz

PLATE 62, FIGURES 22, 23; PLATE 69, FIGURE 55

Pseudochelaria DIETZ, Ent. News, vol. 11, p. 352, 1900. (Genotype, *Pseudochelaria pennsylvanica* Dietz.)

Second joint of labial palpus with even, furrowed brush beneath; terminal joint shorter than second, with apex acute.

Fore wing with veins 3, 4, and 5 nearly equidistant at base, 3 from before the end of the cell, 2 more distant, 6 approximate to 7. Hind wing with veins 3 and 4 connate, 5 cubital, 6 and 7 separate but approximate at base.

Male genitalia with uncus elongate, enlarged at apex, which is 3- or 2-pronged by the presence of short, stout spines. Gnathos large, hook-shaped, also sometimes shortly 3-pronged at tip. Tegumen with large lateral projections. Upper branches of the harpes long, slender, enlarged and flattened on outer half; lower branches of the harpes very small or rudimentary. Vinculum small, with a very long, slender, posterior process. Aedeagus straight or curved, with the entrance opening at base, not lateral.

Female genitalia with rather short, slightly twisted ductus; signum an involuted, spiny, nearly quadrangular plate very similar to those found in the genus *Gelechia;* plate of ostium simple, without lateral lobes.

The genus has never been described in print except by those characters that can be deduced from Dietz's specific description, which did not include the venation. In determining the genotype for Dietz, Lord Walsingham gave him the generic name of the unpublished manuscript; by using it and describing the genotype and one other species Dietz inadvertently became the author of the genus and his definite designation of the genotype as *pennsylvanica* must stand. Bainbrigge-Fletcher [18] erroneously quotes *walsinghami* Dietz as genotype.

Pseudochelaria comprises a small natural group of moths, recognizable on habitus alone. The genus has not been discovered outside of North America.

AMERICAN SPECIES OF PSEUDOCHELARIA

walsinghami Dietz.	*arbutina* (Keifer).
pennsylvanica Dietz.	*manzanitae* (Keifer).
scabrella (Busck).	

The last three of the above species are here transferred to *Pseudochelaria* from *Gelechia.*

[18] List of genera and names used for Microlepidoptera, Mem. Dept. Agr. India, vol. 11, p. 189, 1929.

12. FASCISTA, new genus

PLATE 62, FIGURE 24; PLATE 69, FIGURE 56

Second joint of labial palpus thickened, with an even, slightly furrowed brush on the under side; terminal joint nearly as long as second, slender, acute.

Fore wing with veins 2, 3, and 4 nearly equidistant at base, from before the end of the cell; 5 from end of cell; 6 approximate to stalk of 7 and 8. Hind wing with veins 3 and 4 closely approximate or sometimes connate; 5 cubital, near 4 at base, 6 and 7 closely approximate or connate.

Male genitalia with uncus a long, slightly curved hook with sharp-pointed tip; gnathos elaborately developed, with a large process anteriorly and with a hinged, large, curved, sharp-pointed hook nearly reaching the tip of uncus; harpe long, stout, divided or bilobed at outer fourth into a broad, flattened part and a strong, curved hook; vinculum short and broad, sharply cut off anteriorly and with two hairy processes posteriorly; a small spool-shaped plate, hinged to the vinculum between these two processes, must be considered an anellus, a structure normally absent in the family; aedeagus stout, cylindrical, slightly serrate near apex, entrance hole for penis lateral, near base.

Female genitalia with ductus slightly enlarged and sclerotized just above ductus seminalis, bursa ample, with a single, strong, compressed, sharp signum from a quadrangular base.

The curiously developed gnathos has its counterpart in the even more elaborate gnathos of the genus *Evippe* Chambers (pl. 63, fig. 28), which is probably a derivative of or correlated with *Fascista*.

Genotype, *Gelechia cercerisella* Chambers.[19]

AMERICAN SPECIES OF FASCISTA

cercerisella (Chambers). Synonyms: *olympiadella* (Zeller), *cercerella* (Meyrick).

Synonyms: *quinella* (Zeller). *albipectus* (Walsingham).

The above names are transferred from *Gelechia*.

13. EPILECHIA, new genus

PLATE 62, FIGURE 21; PLATE 69, FIGURE 54

Second joint of labial palpus long and slender, only slightly thickened by a short, furrowed brush on under side; terminal joint as long as second, smooth, acutely pointed.

Fore wings with veins 2, 3, 4, and 5 nearly equidistant; 2 and 3 from before the end of the cell; 6 closer to stalk of 7 and 8 than to 5.

[19] Can. Ent., vol. 4, p. 108, 1872.

Hind wings broader than the fore wings, with veins 3 and 4 connate, 5 cubital, 6 and 7 approximate at base, diverging outwardly; termen but very slightly sinuated below apex.

Male genitalia with a very large hood-shaped uncus and a very large hook-shaped gnathos; harpe simple, flattened, oval, with a single strong spine on the middle of sacculus; aedeagus short, stumpy, with an incision a little below the blunt apex, entrance hole for penis at base, not lateral.

Female genitalia with ductus short; bursa very large; signa two large, curved plates covered with short spines.

The genus, to which at present only one species can be referred, is correlated with and close to *Pectinophora* Busck and feeds like this in the fruit of malvaceous plants, *Hibiscus*. It possesses no antennal pecten.

Genotype, *Gelechia catalinella* Busck.[20]

AMERICAN SPECIES OF EPILECHIA

catalinella (Busck). New synonym: *tehuacana* (Busck).

14. FACULTA, new genus

PLATE 62, FIGURE 20; PLATE 69, FIGURE 53

Second joint of palpus with well-developed, rough, furrowed brush on under side, larger at base than at tip; terminal joint nearly as long as second, smooth, acutely pointed.

Fore wing with vein 2 well before end of cell; veins 3, 4, and 5 equidistant, approximately from end of cell; 6 nearer stalk of 7 and 8. Hind wing with veins 3 and 4 connate, 5 cubital, 6 and 7 separate, nearly parallel.

Male genitalia with uncus a short pointed hook; gnathos flattened, tonguelike, pointed; harpe simple, short, pointed, bent forward; vinculum large, with very large posterior process rounded at tip; aedeagus short, cylindrical, with long, branched, leaflike process at apex; entrance hole for penis at base, slightly lateral.

Female genitalia with short and wide, sclerotized ductus; bursa very large, irregular in outline, upper part armored with numerous long spines close together forming an irregular circle, a single shorter and stouter spine lying separate from the rest; signum large, with four long, curved arms, the two longer cylindrical and pointed, the two shorter flattened and obtuse, from a small base, extending outside the wall of the bursa.

Genotype, *Gelechia triangulella* Busck,[21] the only North American species at present known to belong here.

[20] Journ. New York Ent. Soc., vol. 15, p. 136, 1907.
[21] Proc. Ent. Soc. Washington, vol. 8, p. 91, 1906.

SPECIES TREATED IN THIS PAPER, WITH THEIR GENERIC ASSIGNMENTS

abactella (Clarke), *Filatima.*
abdominella (Busck), *Chionodes.*
abella (Busck), *Chionodes.*
abradescens (Braun), *Filatima.*
acharnaea (Meyrick), *Aroga.*
acrina (Keifer), *Chionodes.*
affinis (Douglas), *Bryotropha.*
alaricella Busck, *Gnorimoschema.*
albangulata Braun, *Gnorimoschema.*
albifemorella (Clarke) (preoccupied), *Filatima.* Synonym of *clarkella* Busck, new name.
albilorella (Zeller), *Filatima.* Synonym: *trifasciella* (Chambers).
albimarginella (Chambers), *Gnorimoschema.*
albipectus (Walsingham), *Fascista.*
albisparsella (Chambers), *Gelechia.* Synonym: *platanella* (Chambers).
albomaculella (Chambers), *Chionodes.* Synonym of *continuella* (Zeller).
alleriella Busck, *Aroga.*
alpicola (Frey), *Lita.* Synonym of *longicornis* (Curtis).
alternatella (Kearfott), *Lita.* Synonym of *longicornis* (Curtis).
altisolani (Keifer), *Keiferia.*
ambrosiaeella (Chambers), *Gnorimoschema.*
amorphaeella (Chambers), *Filatima.*
anarsiella Chambers, *Gelechia.*
anisectis (Meyrick), *Bryotropha.* Synonym of *inaequalis* (Busck).
arborei (Keifer), *Chionodes.* Synonym of *braunella* (Keifer).
arbutina (Keifer), *Pseudochelaria.*
arenella (Forbes), *Chionodes.*
argentipunctella (Ely), *Chionodes.*
aristella (Busck), *Aroga.*
arizonella (Busck), *Filatima.*
asinella Zeller, *Gelechia.*
atriplex Busck, *Gnorimoschema.*
auleae Clarke, *Filatima.*
artimisiella Kearfott (preoccupied), *Gnorimoschema.* Synonoym of *axenopis* (Meyrick).
axenopis (Meyrick), *Gnorimoschema.* Synonym: *artimisiella* Kearfott (preoccupied).
baccharisella Busck, *Gnorimoschema.*
banksiella Busck, *Gnorimoschema.*
barnesiella (Busck), *Lita.*
batanella (Busck), *Gnorimoschema.*
beneficentella (Murtfeldt), *Frumenta.* Synonym of *nundinella* (Zeller).
benitella Barnes and Busck, *Gelechia.*
bianulella (Chambers), *Gelechia.* Synonyms: *ocellella* (Chambers), *sabinella* Meyrick (*nec* Zeller).
bicostomaculella (Chambers), *Chionodes.* Synonyms: *gibbosella* (Chambers), *quercifoliella* (Chambers).
biforella (Busck), *Filatima.*
bigella (Busck), *Filatima.* New synonym: *spilosella* (Barnes and Busck).
bimaculella (Chambers), *Filatima.* Synonyms: *sylvaecolella* (Chambers), *ternariella* (Zeller).

biminimaculella (Chambers), *Filatima*. Synonym of *gilvomaculella* (Chambers).
brackenridgiella Busck, *Gnorimoschema*. Synonym: *detersella* (Clemens).
branella (Busck), *Bryotropha*.
braunella (Keifer), *Chionodes*. Synonym: *arboreï* (Keifer).
busckiella Kearfott, *Gnorimoschema*.
caecella (Zeller), *Filatima*. Synonym of *pseudoacaciella* (Chambers).
caesiella (Brodie), *Gnorimoschema*. Synonym of *gallaeasteriella* (Kellicott).
camptogramma (Meyrick), *Aroga*.
canopulvella Chambers, *Gelechia*. Synonym of *obscurosuffusella* Chambers.
caryaevorella (Packard), *Chionodes*.
catacrossa (Meyrick), *Filatima*.
catalinella (Busck), *Epilechia*. New synonym: *tchuacana* (Busck).
caudata Clarke, *Gelechia*.
ceanothiella (Busck), *Chionodes*. New synonym: *marinensis* (Keifer).
cercerella (Meyrick), *Fascista*. Synonym of *cercerisella* (Chambers).
cercerisella (Chambers), *Fascista*. Synonyms: *olympiadella* (Zeller), *cercerella* (Meyrick).
chambersella (Dyar), *Lita*. Synonym of *texanella* (Chambers).
charcoti (Meyrick), *Gnorimoschema*.
chenopodiella Busck, *Gnorimoschema*.
chiquitella Busck, *Gnorimoschema*.
chlorocrana (Meyrick), *Aroga*.
chloroschema (Meyrick), *Chionodes*.
chrysopyla (Keifer), *Chionodes*.
cinerella (Murtfeldt), *Gnorimoschema*. Synonym of *glochinella* (Zeller).
clandestina (Meyrick), *Bryotropha*.
clarkella Busck, *Filatima*. New name for *albifemorella* (Clarke) (preoccupied).
cockerelli (Busck), *Friseria*.
collinusella (Chambers), *Gnorimoschema*.
coloradensis (Busck), *Aroga*.
compsomorpha Meyrick, *Gnorimoschema*.
confusella (Chambers) (preoccupied), *Filatima*. Synonym of *persicaeella* (Murtfeldt).
consueta Braun, *Gnorimoschema*.
continuella (Zeller), *Chionodes*. Synonyms: *trimaculella* (Packard), *albomaculella* (Chambers).
contraria Braun, *Gnorimoschema*.
coquillettella Busck, *Gnorimoschema*.
coticola (Busck), *Chionodes*. New synonym: *notochlora* (Meyrick).
cuneatella Duponchel, *Gelechia*.
dammersi (Keifer), *Chionodes*.
decrepidella (Herrich-Schaeffer), *Bryotropha*.
demissae (Keifer), *Filatima*.
dentella (Busck), *Chionodes*.
depressostrigella (Chambers), *Filatima*. Synonym of *ochreosuffusella* (Chambers).
depuratella (Busck), *Filatima*.
desertella (Douglas), *Bryotropha*.
desiliens Meyrick, *Gelechia*.
detersella (Clemens), *Gnorimoschema*. Synonym of *brackenridgiella* Busck.
discomaculella (Chambers), *Gnorimoschema*.
discoocellella (Chambers), *Chionodes*. Synonym: *violaceofusca* (Zeller).
distinctella (Zeller), *Chionodes*.
diversella (Busck), *Lita*.

dromicella Busck, *Gelechia.*
dudiella Busck, *Gnorimoschema.*
dyariella Busck, *Gelechia.*
eldorado (Keifer), *Aroga.*
elmorei (Keifer), *Keiferia.*
emancipata (Meyrick), *Gnorimoschema.* Synonym: *marmorella* (Chambers).
epigaeella (Chambers), *Aroga.* Synonym of *trialbamaculella* (Chambers).
ericameriae Keifer, *Gnorimoschema.*
erigeronella Braun, *Gnorimoschema.*
eriogonella (Clarke), *Aroga.*
eucausta Meyrick, *Gnorimoschema.*
faustella Busck, *Gnorimoschema.*
ferculatia Meyrick, *Gnorimoschema.*
figurella (Busck), *Chionodes.*
florella Busck, *Gnorimoschema.*
fluvialella (Busck), *Chionodes.*
fondella (Busck), *Chionodes.*
fructuaria (Braun), *Chionodes.*
fulginea (Meyrick), *Filatima.*
fulmenella (Busck), *Lita.* Synonym of *prorepta* (Meyrick).
fuscoochrella (Chambers), *Chionodes.* Synonym of *mediofuscella* (Clemens).
fuscotaeniella (Chambers), *Friseria.*
gallaeasteriella (Kellicott), *Gnorimoschema.* Synonyms: *caesiella* (Brodie), *gallaediplopappi* (Fyles).
gallaediplopappi (Fyles), *Gnorimoschema.* Synonym of *gallaeasteriella* (Kellicott).
gallaesolidaginis (Riley), *Gnorimoschema.*
gibbosella (Chambers), *Chionodes.* Synonym of *bicostomaculella* (Chambers).
gibsoniella Busck, *Gnorimoschema.*
gilvomaculella (Clemens), *Filatima.* Synonym: *biminimaculella* (Chambers).
glochinella (Zeller), *Keiferia.* Synonyms: *solaniella* (Chambers), *cinerella* (Murtfeldt), *inconspicuella* (Murtfeldt).
gomphopis (Meyrick), *Filatima.*
grisella (Chambers), *Gnorimoschema.* Synonym *discomaculella* (Chambers).
gudmannella (Walsingham), *Gnorimoschema.*
helicosticta (Meyrick), *Chionodes.*
hemicrossa (Meyrick), *Filatima.*
henshawiella Busck, *Gnorimoschema.* Synonym: *ochreostrigella* (Chambers).
hibiscella (Busck), *Chionodes.*
hippophaella Zeller, *Gelechia.*
hipposaris (Meyrick), *Aroga.*
inaequalis (Busck), *Bryotropha.* Synonyms, *inaequalis* (Welsingham), *antisectis* (Meyrick).
inconspicuella (Murtfeldt), *Gnorimoschema.* Synonym of *glochinella* (Zeller).
inexperta (Meyrick), *Gnorimoschema.*
inquilinella (Busck), *Filatima.*
invariabilis (Kearfott), *Lita.*
isocrossa (Meyrick), *Filatima.*
kincaidella (Busck), *Chionodes.*
labradoriella (Clemens), *Chionodes.* Synonym of *viduella* (Fabricius).
laguna Busck, *Gnorimoschema.*
langei (Keifer), *Chionodes.* New synonym of *retiniella* (Barnes and Busck).
lavernella (Chambers), *Gnorimoschema.* Synonym: *physalivorella* (Chambers).
lectulifera Meyrick, *Gnorimoschema.*

lepidotae (Clarke), *Filatima.*
leucaniella (Busck), *Aroga.*
leucocephala (Walsingham), *Chionodes.*
lindenella (Busck), *Friseria.*
lipatiella Busck, *Gnorimoschema.*
liturosella (Zeller), *Chionodes.* Synonym of *mediofuscella* (Clemens).
longicornis (Curtis), *Lita.* Synonyms: *alternatella* (Kearfott), *alpicola* (Frey), *petulans* (Braun).
lophella (Meyrick), *Chionodes.* Synonym of *lophosella* (Busck).
lophosella (Busck), *Chionodes.* Synonym: *lophella* (Meyrick).
luctificella Hübner, *Chionodes.* Synonym of *lugubrella* (Fabricius).
lugubrella (Fabricius), *Chionodes.* Synonym: *luctificella* Hübner.
luteogeminata (Clarke), *Chionodes.*
lutescella Clarke, *Gnorimoschema.*
lycopersicella (Busck), *Keiferia.*
lynceella Zeller, *Gelechia.*
macromaculata Braun, *Gnorimoschema.*
maculimarginella (Chambers), *Chionodes.*
malinaella (Busck), *Friseria.*
mandella Busck, *Gelechia.*
manzanitae (Keifer), *Pseudochelaria.*
marinensis (Keifer), *Chionodes.* New synonym of *ceanothiella* Busck.
marmorella (Chambers), *Gnorimoschema.*
mediofuscella (Clemens), *Chionodes.* Synonyms: *vagella* (Walker), *liturosella* (Zeller), *rhedaria* (Meyrick), *fuscoochrella* (Chambers).
melanoplintha (Meyrick), *Gnorimoschema.* New synonym of *plaesiosema* (Turner).
metallica (Braun), *Chionodes.*
milleriella (Chambers), *Gnorimoschema.*
minimaculella (Chambers), *Filatima.*
minor (Busck), *Gnorimoschema.*
miscitatella Clarke, *Gnorimoschema.*
monella Busck, *Gelechia.*
monopa (Meyrick), *Filatima.*
monotaeniella (Bottimer), *Filatima.*
monumentella (Chambers), *Aroga.*
morenella (Busck), *Aroga.*
muscosella Zeller, *Gelechia.*
nanodella (Busck), *Chionodes.*
natalis (Heinrich), *Filatima.*
negundella (Heinrich), *Chionodes.*
neopetrella Keifer, *Gnorimoschema.*
neotrophella (Heinrich), *Filatima.*
nigra Haworth, *Gelechia.*
nigrimaculella (Busck), *Chionodes.*
normifera (Meyrick), *Filatima.*
notandella (Busck), *Chionodes.*
notochlora (Meyrick), *Chionodes.* New synonym of *coticola* (Busck).
nundinella (Zeller), *Frumenta.* Synonym: *beneficentella* (Murtfeldt).
obscuripennis Frey, *Gelechia.*
obscuroocellella (Chambers), *Filatima.*
obscurosuffusella Chambers, *Gelechia.* Synonym: *canopulvella* Chambers.
occidentella (Chambers), *Chionodes.*
ocellella Chambers, *Gelechia.* Synonym of *bianulella* (Chambers).

ochreostrigella (Chambers), *Chionodes.*
ochreostrigella (Chambers), *Gnorimoschema.* Synonym of *henshawiella* Busck.
ochreosuffusella (Chambers), *Filatima.* Synonym: *depressostrigella* (Chambers).
ochroschista (Meyrick), *Gnorimoschema.*
octomaculella (Chambers), *Gnorimoschema.*
olympiadella (Zeller), *Fascista.* Synonym of *cercerisella* (Chambers).
operculella (Zeller), *Gnorimoschema.* Synonyms: *solanella* (Boisduval), *tabacella* (Ragonot).
ornatifimbriella (Clemens), *Filatima.* Synonym: *unctulella* (Zeller).
pallidochrella (Chambers), *Gnorimoschema.*
panella Busck, *Gelechia.*
paralogella (Busck), *Chionodes.*
paraplutella (Busck), *Aroga.*
paulella (Busck), *Aroga.*
pennsylvanica Dietz, *Pseudochelaria.*
periculella (Busck), *Chionodes.*
persicaecella (Murtfeldt), *Filatima.* Synonym: *confusella* (Chambers).
petrella Busck, *Gnorimoschema.*
petulans (Braun), *Lita.* Synonym of *longicornis* (Curtis).
physalivorella (Chambers), *Gnorimoschema.* Synonym of *laverniella* (Chambers).
pinguicula (Meyrick), *Chionodes.*
pinguinella Treitschke, *Gelechia.*
plaesiosema (Turner), *Gnorimoschema.* New synonyms: *melanoplintha* (Meyrick), *tuberosella* Busck.
platanella (Chambers), *Gelechia.* Synonym of *albisparsella* (Chambers).
polemoniella (Braun), *Gnorimoschema.*
potentella Keifer, *Gnorimoschema.*
pravinominella (Chambers), *Filatima.* Synonym: *quadrimaculella* (Chambers).
princeps Busck, *Gnorimoschema.*
promonitrix (Meyrick), *Filatima.*
prorepta (Meyrick), *Lita.* Synonym: *fulmenella* (Busck).
pseudoacaciella (Chambers), *Filatima.* Synonym: *caecella* (Zeller).
pseudofondella (Busck), *Chionodes.*
psiloptera (Barnes and Busck), *Chionodes.*
puertella (Busck), *Lita.*
pullifimbriella (Clemens), *Filatima.*
quadrimaculella (Chambers), *Filatima.* Synonym of *pravinominella* (Chambers).
quercifoliella (Chambers), *Chionodes.* Synonym of *bicostomaculella* (Chambers).
quinella (Zeller), *Fascista.*
radiatella Busck, *Gnorimoschema.*
rectistrigella (Busck), *Lita.*
repentina (Walsingham), *Friseria.*
retiniella (Barnes and Busck), *Chionodes.* New synonym: *langei* (Keifer).
rhedaria (Meyrick), *Chionodes.* Synonym of *mediofuscella* (Clemens).
rhombella (Schiffermüller), *Gelechia.*
rhombelliformis Staudinger, *Gelechia.*
ribesella Chambers, *Gelechia.*
rigidae (Clarke), *Aroga.*
rileyella (Chambers), *Gelechia.*

rivulata (Meyrick), *Filatima.*
sabinella Zeller, *Gelechia.*
sabinella (Meyrick) (nec Zeller), *Gelechia.* Synonym of *bianulella* Chambers.
sacculicola (Braun), *Gnorimoschema.*
saliciphaga (Keifer), *Filatima.*
salinaris Busck, *Gnorimoschema.*
saphirinella (Chambers), *Gnorimoschema.*
sarcochlora (Meyrick), *Friseria.*
scabrella (Busck), *Pseudochelaria.*
scotinella Herrich-Schaeffer, *Gelechia.*
scutellariaeella (Chambers), *Gnorimoschema.*
seculaella (Clarke), *Chionodes.*
semicyclionella Busck, *Gnorimoschema.*
semirosea Meyrick, *Gnorimoschema.*
septentrionella (Fyles), *Gnorimoschema.*
serotinella (Busck), *Filatima.*
serratipalpella (Chambers), *Gnorimoschema.*
simpliciella (Chambers), *Gnorimoschema.*
sistrella (Busck), *Chionodes.*
solanella (Boisduval), *Gnorimoschema.* Synonym of *operculella* (Chambers).
solaniella (Chambers), *Gnorimoschema.*
solutella (Zeller), *Lita.*
sororealella Hübner, *Gelechia.*
spilosella (Barnes & Busck), *Filatima.* New synonym of *bigella* (Busck).
splendoriferella Busck, *Gnorimoschema.*
sporomochla Meyrick, *Gnorimoschema.*
striatella (Busck), *Filatima.*
striatella (Murtfeldt), *Gnorimoschema.*
subterranea Busck, *Gnorimoschema.*
sylvaecolella (Chamber), *Filatima.* Synonym of *bimaculella* (Chambers).
tabacella (Ragenot), *Gnorimoschema.* Synonym of *operculella* (Zeller).
tehuacana (Busck), *Epilechia.* New synonym of *catalinella* (Busck).
terminimaculella (Kearfott), *Chionodes.*
ternariella (Zeller), *Filatima.* Synonym of *bimaculella* (Chambers).
terracottella Busck, *Gnorimoschema.*
terrella (Schiffermüller), *Bryotropha.*
tetradymiella Busck, *Gnorimoschema.*
texanella (Chambers), *Lita.* Synonym: *chambersella* (Dyar).
thoracealbella (Chambers), *Chionodes.*
trachycosma (Meyrick), *Chionodes.*
trialbamaculella (Chambers), *Aroga.* Synonym: *epigaeella* (Chambers).
triangulella (Busck), *Faculta.*
trichostola (Meyrick), *Chionodes.*
trifasciella (Chambers), *Filatima.* Synonym of *albilorella* (Zeller).
trilineella Chambers, *Gelechia.*
trimaculella (Packard), *Chionodes.* Synonym of *continuella* (Zeller).
triocellella (Chambers), *Gnorimoschema.*
trophella (Busck), *Chionodes.*
tuberosella Busck, *Gnorimoschema.* New synonym of *plaesiosema* (Turner).
unctulella (Zeller), *Filatima.* Synonym of *ornatifimbriella* (Clemens).
unifasciella (Busck), *Aroga.*
vagella (Walker), *Chionodes.* Synonym of *mediofuscella* (Clemens).
vanduzeei (Keifer), *Chionodes.*

variabilis (Busck), *Lita.*
variana Meyrick, *Stegasta.*
vastifica Braun, *Gnorimoschema.*
velocella (Duponchel), *Aroga.*
vernella (Murtfeldt), *Chionodes.*
versicolorella (Chambers), *Gnorimoschema.*
versutella Zeller, *Gelechia.*
viduella (Fabricius), *Chionodes.* Synonym: *labradoriella* (Clemens).
violaceofusca (Zeller), *Chionodes.* Synonym of *discoocellella* (Chambers).
walsinghami Dietz, *Pseudochelaria.*
washingtoniella Busck, *Gnorimoschema.*
xanthophilella (Barnes and Busck), *Chionodes.*
xanthuris (Meyrick), *Filatima.*

UNRECOGNIZED SPECIES

The following species are unknown to me except from the descriptions, which are not sufficient to place them properly. The species in this list described by Meyrick and Braun will eventually be placed by examination of the types; but the fact that these species remain unrecognized except by the author is a good example of the impropriety of keeping types in private collections, where they can be examined only by other workers at the pleasure and convenience of the author. When anyone adds to the nomenclature by describing new species he imposes upon the rest of the workers of the world the obligation to deal with these new names. The types, therefore, become a public concern and should be placed in an institution where any qualified worker can examine them.

Chambers' species, of which the types are lost and the short descriptions of which are quite insufficient for certain recognition, must eventually be arbitrarily fixed by selecting species from the type locality that do not disagree with Chambers' description and attaching Chambers' names to them. This much-needed work is outside the scope of this paper. In the meantime all these species must be retained in *Gelechia*, where they were described, although most of them probably belong in other genera.

agriodes Meyrick. Utah.
asbolodes Meyrick. Texas.
attritella Walker. Oregon.
badiomaculella Chambers. Kentucky.
bispiculata Meyrick. Arizona, Texas.
bistrigella Chambers. Canada.
brumella Clemens. Labrador.
capiteochrella Chambers. Texas.
clistrodoma Meyrick. Arizona.
collinearis Meyrick. Texas.
conspersa Braun. Montana.
decemmaculella Chambers. Colorado.
discostrigella Chambers. California.
elaboratella Braun. California.
epigypsa Meyrick. Texas.
flavicorporella Walsingham. Massachusetts.
frugalis Braun. Utah.
fuscolutella Chambers. Kentucky.
fuscomaculella Chambers. Kentucky.
glycyrhizaeella Chambers. Colorado.
griseochrella Chambers. California.
halycopa Meyric. Texas.
intermedia Braun. California.
maculatuscella Chambers. California.
mimella Clemens. Pennsylvania.
nigrobarbata Braun. Canada.
obscurella Chambers. Kentucky.
obscurusella Chambers. Synonym: *fuscopulvella* Chambers. Kentucky.
occlusa Braun. Canada.
ocherfuscella Chambers. Synonym: *ochreofuscella* Meyrick. California.
packardella Chambers. Colorado.
pallidegrisecla Chambers. Texas.
palpialbella Chambers. Kentucky.
parvipulvella Chambers. Texas.
permacta Braun. Canada.
prognosticata Braun. Utah.
pullusella Chambers. Synonyms: *pullella* Meyrick, *minimella* Chambers. Texas.
speculifera Meyrick. Arkansas.
thoraceochrella Chambers. Kentucky.
thoracestrigella Chambers. California.
unistrigella Chambers. Kentucky.
wacoella Chambers. Texas.
xyloglypta Meyrick. California.

EXPLANATION OF PLATES

PLATE 58

1–1b. *Gelechia bianulella* (Chambers): 1, Male genitalia, aedeagus removed; 1a, aedeagus; 1b, eighth abdominal segment. Genotype of *Oescis*.

2–2b. *Gnorimoschema gallaesolidaginis* (Riley): 2, Male genitalia, aedeagus removed; 2a, aedeagus; 2b, eighth abdominal segment. Genotype.

3–3b. *Keiferia altisolani* (Keifer): 3, Male genitalia, aedeagus removed; 3a, aedeagus; 3b, eighth abdominal segment.

4–4b. *Friseria lindenella* (Busck): Male genitalia, aedeagus removed; 4a, aedeagus; 4b, eighth abdominal segment. Genotype.

5–5b. *Lita longicornis* (Curtis): 5, Male genitalia, aedeagus removed; 5a, aedeagus; 5b, eighth abdominal segment. Genotype.

PLATE 59

6–6b. *Chionodes lugubrella* (Fabricius): 6, Male genitalia; 6a, aedeagus; 6b, eighth abdominal segment. Genotype.

7–7c. *Chionodes fondella* (Busck): 7, Male genitalia, aedeagus removed; 7a, aedeagus; 7b, eighth abdominal segment; 7c, uncus, ventral view.

8–8d. *Chionodes trichostola* (Meyrick): 8, Male genitalia, aedeagus removed; 8a, aedeagus; 8b, eighth abdominal segment; 8c, 8d, variations of tips of harpes.

9–9a. *Chionodes mediofuscella* (Clemens): 9, Male genitalia; 9a, eighth abdominal segment.

PLATE 60

10. *Bryotropha terrella* (Schiffermüller): 10, Male genitalia. Genotype.

11–11b. *Filatima ornatifimbriella* (Chambers): 11, Male genitalia, aedeagus removed; 11a, aedeagus; 11b, eighth abdominal segment.

12–12b. *Filatima serotinella* (Busck): 12, Male genitalia, aedeagus removed; 12a, aedeagus; 12b, eighth abdominal segment. Genotype.

13–13b. *Filatima albilorella* (Zeller): 13, Male genitalia, aedeagus removed; 13a, aedeagus; 13b, eighth abdominal segment.

14–14b. *Frumenta nundinella* (Zeller): 14, Male genitalia, aedeagus removed; 14a, aedeagus; 14b, eighth abdominal segment. Genotype.

PLATE 61

15–15b. *Aroga paulella* (Busck): 15, Male genitalia; 15a, dorsal view of eighth abdominal segment; 15b, lateral view of eighth abdominal segment.

16–16b. *Aroga paraplutella* Busck: 16, Male genitalia, aedeagus removed; 16a, aedeagus; 16b, dorsal view of eighth abdominal segment. Genotype.

17–17b. *Aroga alleriella* Busck: 17, Male genitalia, aedeagus removed; 17a aedeagus; 17b, eighth abdominal segment.

18. *Keiferia altisolani* (Keifer): Wing venation.

19. *Gelechia rhombella* (Schiffermüller): Wing venation.

PLATE 62

20–20b. *Faculta triangulella* (Busck): 20, Male genitalia, aedeagus removed; 20a, aedeagus; 20b, eighth abdominal segment. Genotype.
21–21a. *Epilechia catalinella* (Busck): 21, Male genitalia, aedeagus removed; 21a, aedeagus. Genotype.
22–22b. *Pseudochelaria walsinghami* Dietz: 22, Male genitalia, aedeagus removed; 22a, aedeagus; 22b, eighth abdominal segment.
23. *Pseudochelaria pennsylvanica* Dietz: Male genitalia. Genotype.
24–24b. *Fascista cercerisella* (Chambers): 24, Male genitalia, aedeagus removed 24a, aedeagus; 24b, eighth abdominal segment. Genotype.

PLATE 63

25–28. *Nothris verbascella* Hübner: 25, Male genitalia, aedeagus removed; 25a, aedeagus. Genotype.
26–26b. *Stegasta variana* Meyrick: 26, Male genitalia, aedeagus removed; 26a, aedeagus; 26b, eighth abdominal segment. Genotype.
27–27b. *Stegasta bosquella* (Chambers): 27, Male genitalia, aedeagus removed; 27a, aedeagus; 27b, eighth abdominal segment.
28–28b. *Evippe prunifoliella* Chambers: 28, Male genitalia, aedeagus removed; 28a, aedeagus; 28b, eighth abdominal segment. Genotype.
29–29a. *Anacampsis populella* (Clerck): 29, Male genitalia, aedeagus removed; 29a, aedeagus. Genotype.

PLATE 64

30–30b. *Recurvaria nanella* (Hübner): 30, Male genitalia, aedeagus removed; 30a, aedeagus; 30b eighth abdominal segment. Genotype.
31. *Strobisia iridipennella* Clemens: Male genitalia, ventral view, aedeagus removed. Genotype.
32–32a. *Strobisia iridipennella* Clemens: 32, Male genitalia, lateral view, aedeagus removed; 32a, aedeagus. Genotype.
33–33a. *Dichomeris ligulella* Hübner: 33, Male genitalia, aedeagus removed; 33a, aedeagus. Genotype.

PLATE 65

34. *Gelechia bianulella* (Chambers): Female genitalia. Genotype of *Oeseis*.
35. *Keiferia altisolani* (Keifer): Female genitalia.
36. *Gnorimoschema gallaesolidaginis* (Riley): Female genitalia. Genotype.
37. *Lita longicornis* (Curtis): Female genitalia. Genotype.
38. *Lita puertella* (Busck): Profile of head, denuded. Female.
39. *Lita invariabilis* (Kearfott): Profile of head, denuded. Female.

PLATE 66

40. *Chionodes lugubrella* (Fabricius): Female genitalia. Genotype.
41. *Chionodes fondella* (Busck): Female genitalia.
42. *Chionodes trichostola* (Meyrick): Female genitalia.
43. *Chionodes mediofuscella* (Clemens): Female genitalia.
44. *Filatima ornatifimbriella* (Chambers): Female genitalia.

PLATE 67

45. *Bryotropha terrella* (Schiffermüller): Female genitalia. Genotype.
46. *Friseria lindenella* (Busck): Female genitalia. Genotype.
47. *Filatima serotinella* (Busck): Female genitalia. Genotype.
48. *Filatima albilorella* (Zeller): Female genitalia.

PLATE 68

49. *Frumenta nundinella* (Zeller). Female genitalia. Genotype.
50. *Aroga paulella* (Busck): Female genitalia.
51. *Aroga alleriella* (Busck): Female genitalia.
52. *Aroga paraplutella* (Busck): Female genitalia. Genotype.

PLATE 69

53. *Faculta triangulella* (Busck): Female genitalia. Genotype.
54. *Epilechia catalinella* (Busck): Female genitalia. Genotype.
55. *Pseudochelaria walsinghami* Dietz: Female genitalia.
56–56a. *Fascista cercerisella* (Chambers): 56, Female genitalia; 56a, signum. Genotype.

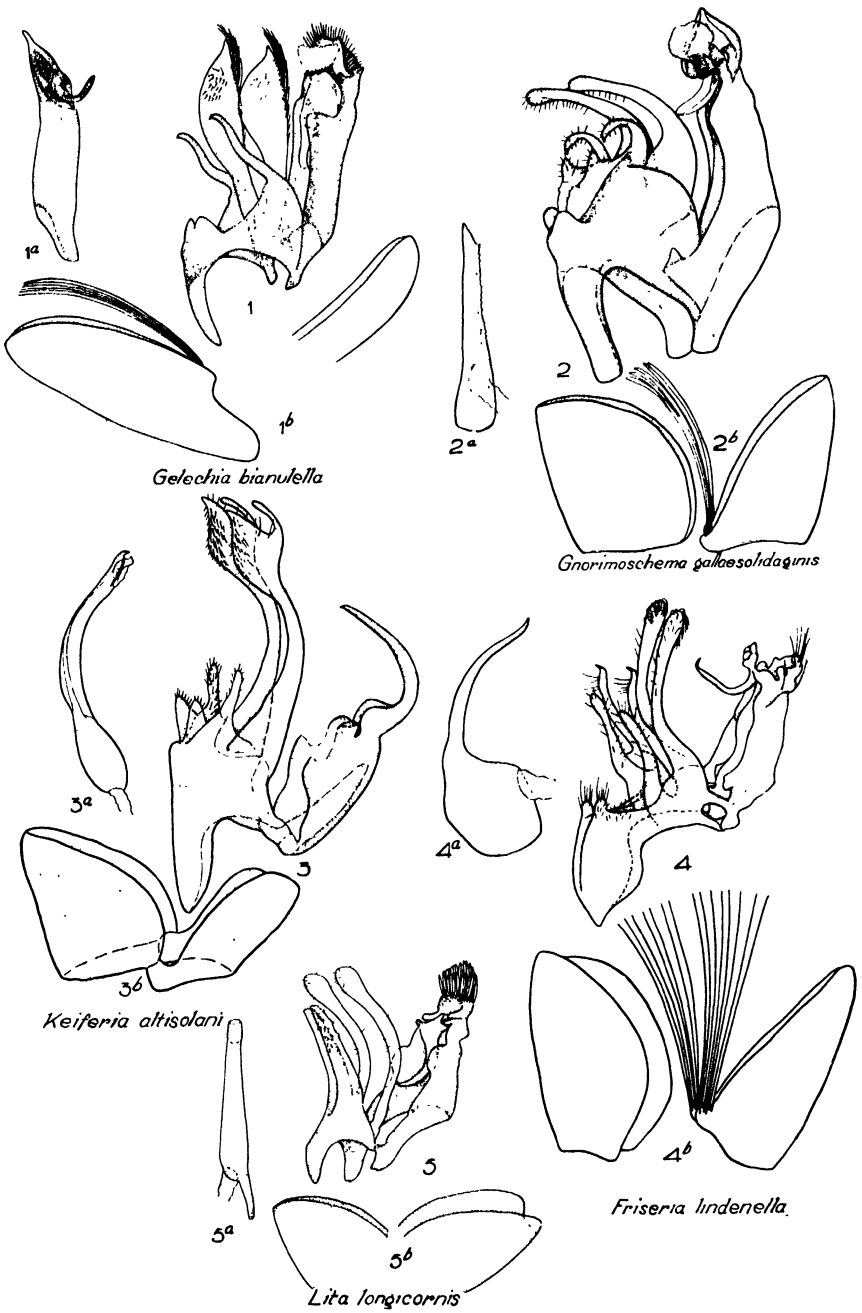
PLATE 70

57. *Evippe prunifoliella* Chambers: Female genitalia. Genotype.
58. *Recurvaria nanella* (Hübner): Female genitalia. Genotype.
59. *Strobisia iridipennella* Clemens: Female genitalia. Genotype.
60. *Stegasta bosquella* (Chambers): Female genitalia.
61. *Stegasta variana* Meyrick: Female genitalia. Genotype.

PLATE 71

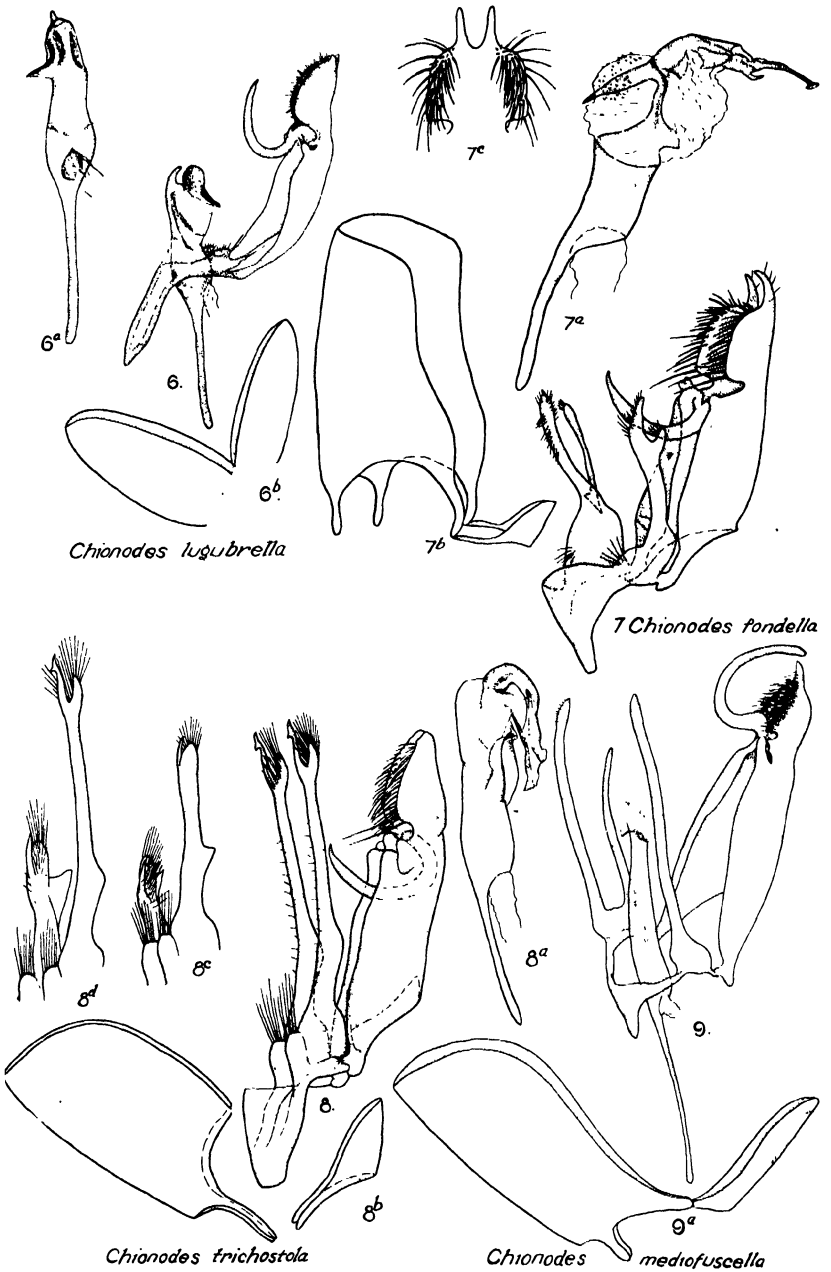
62. *Dichomeris ligulella* Hübner: Female genitalia. Genotype.
63. *Nothris verbascella* (Hübner): Female genitalia. Genotype.
64. *Anacampsis populella* (Clerck): Female genitalia. Genotype.

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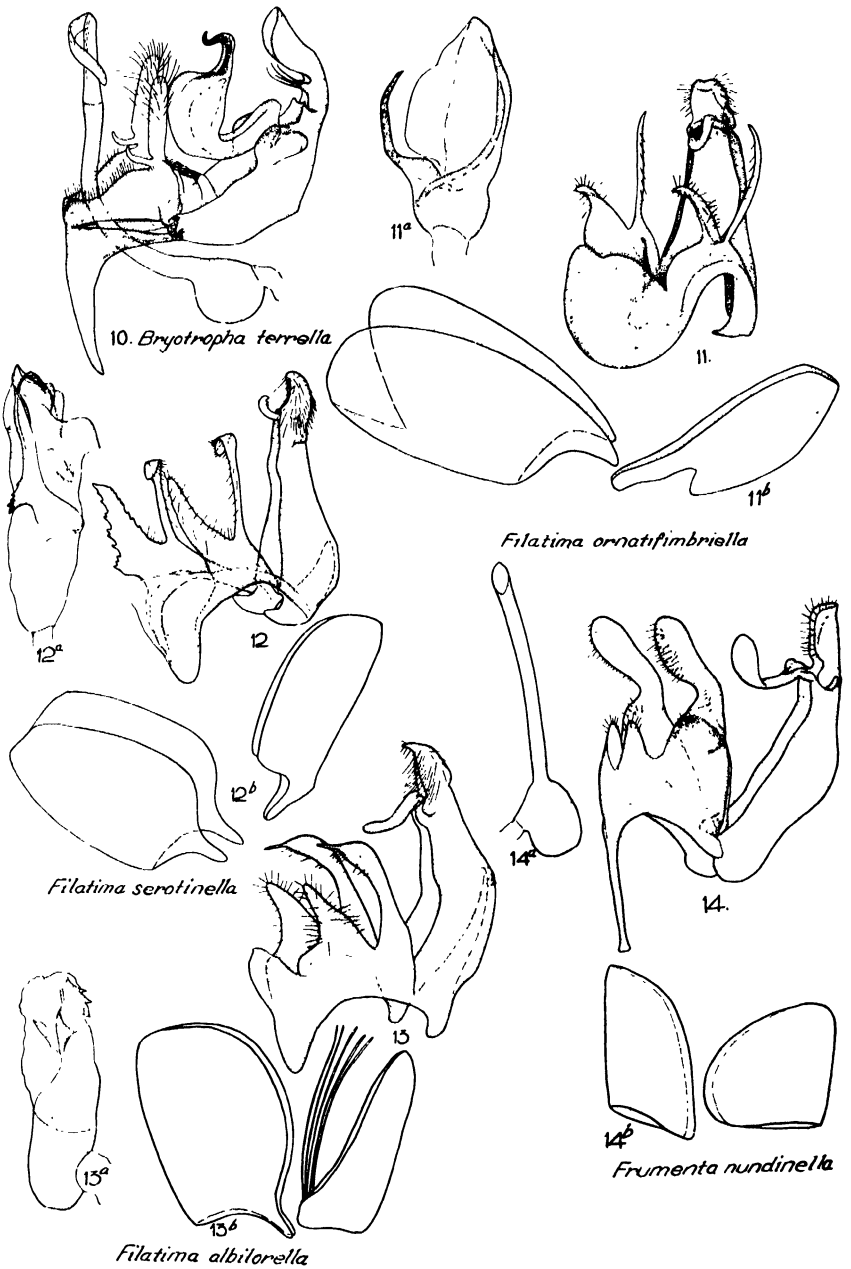
MALE GENITALIA OF GELECHIA, GNORIMOSCHEMA, KEIFERIA, FRISERIA, AND LITA.

FOR EXPLANATION OF PLATE SEE PAGE 591.



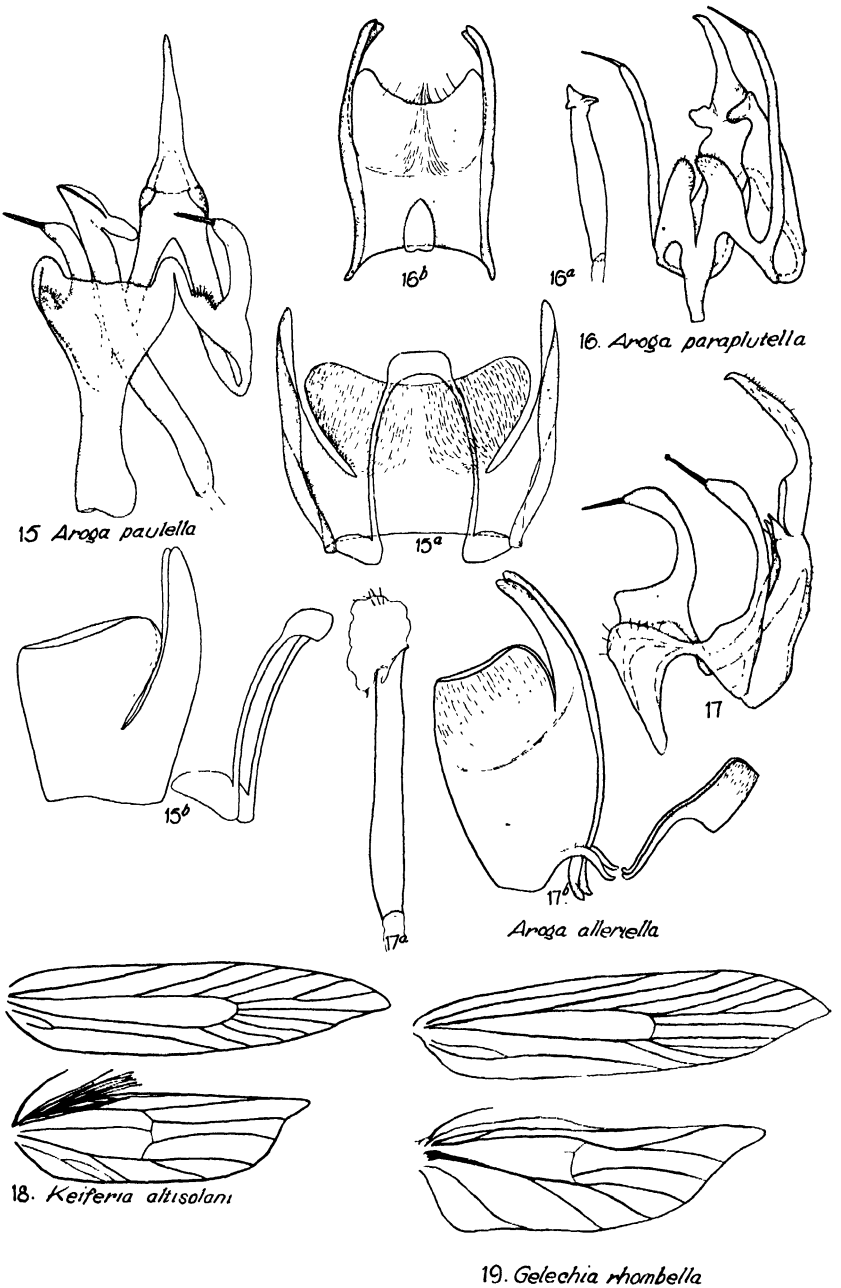
MALE GENITALIA OF CHIONODES.

FOR EXPLANATION OF PLATE SEE PAGE 591.



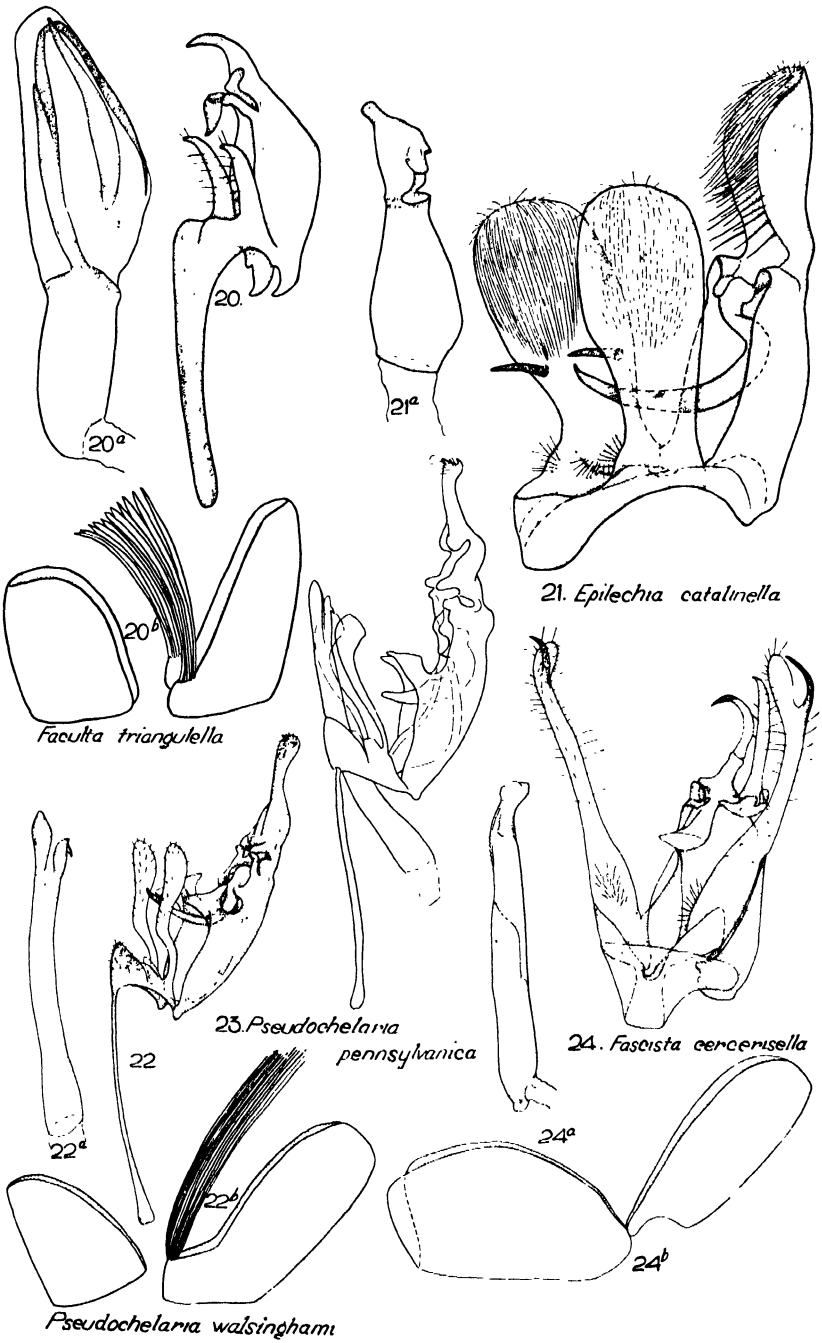
MALE GENITALIA OF BRYOTROPHA, FILATIMA, AND FRUMENTA.

FOR EXPLANATION OF PLATE SEE PAGE 591.



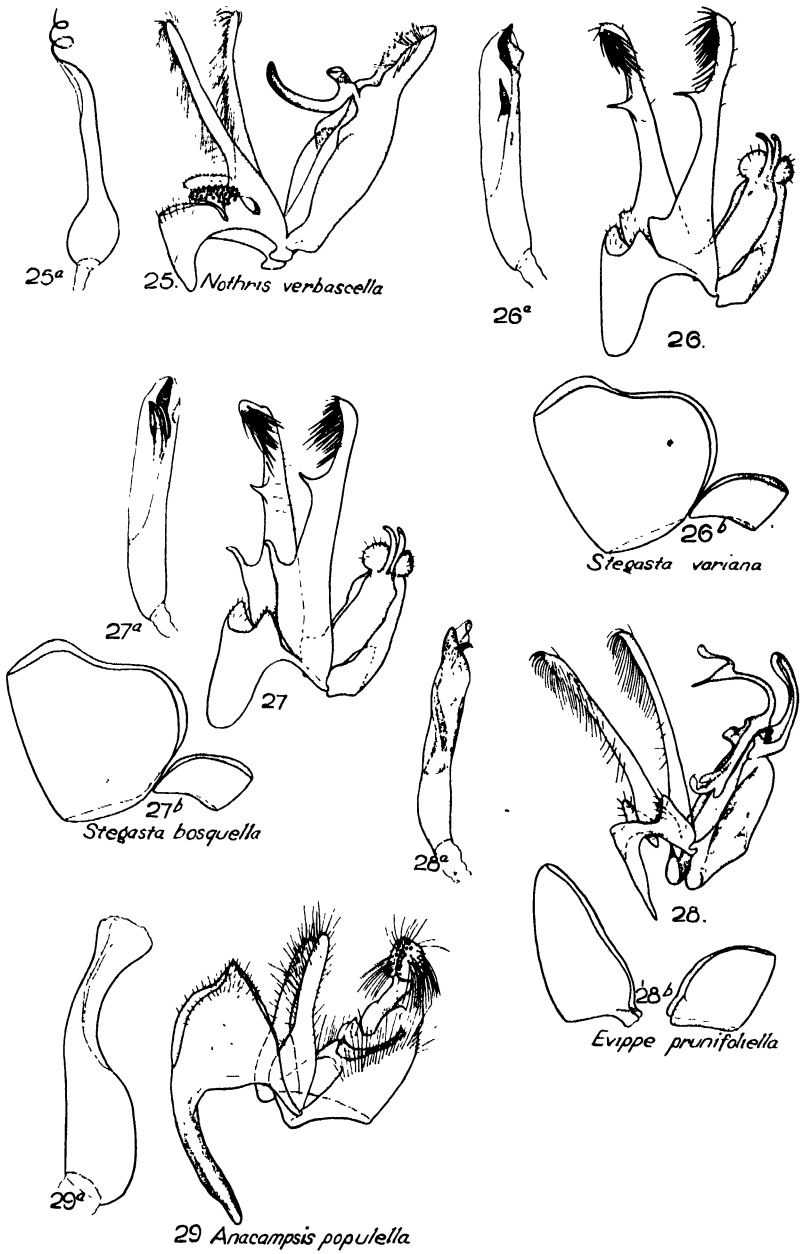
MALE GENITALIA OF AROGA AND WING VENATION OF KEIFERIA AND GELECHIA.

FOR EXPLANATION OF PLATE SEE PAGE 591.



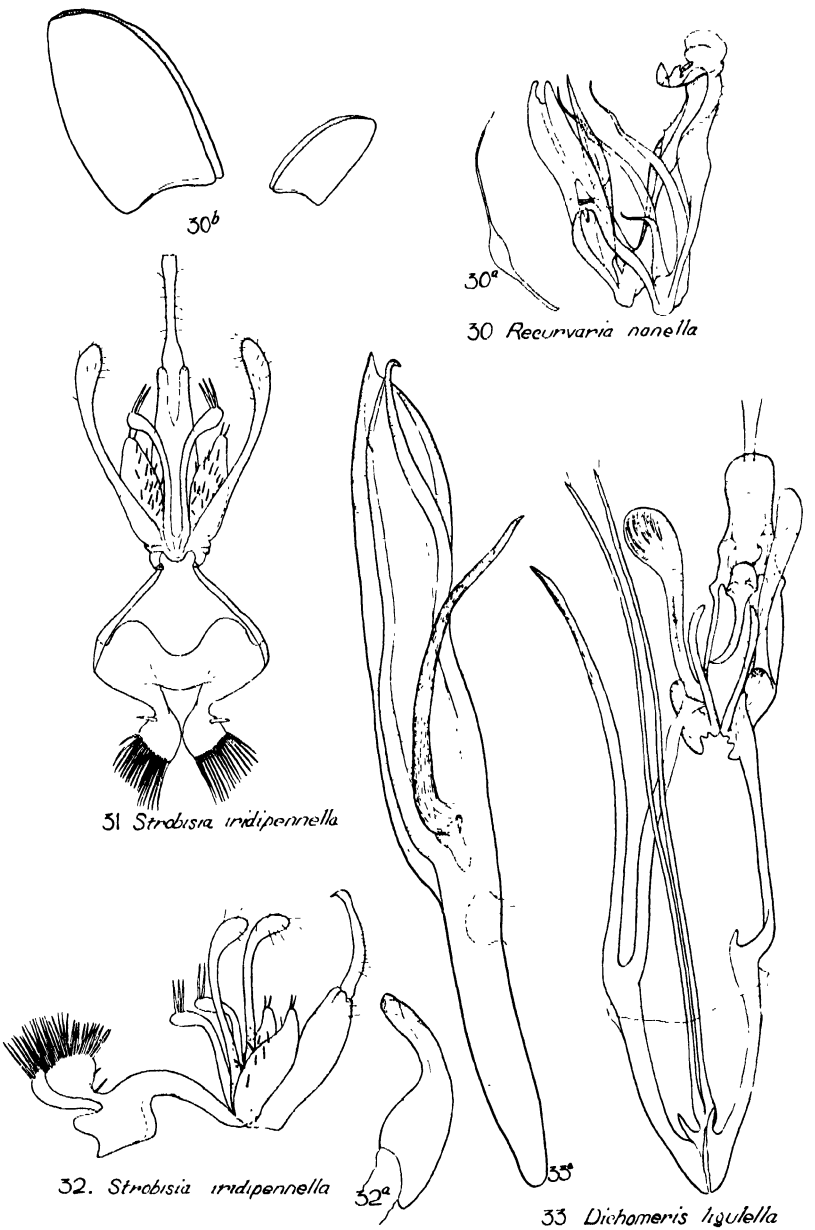
MALE GENITALIA OF FACULTA, EPILECHIA, PSEUDOCHELARIA, AND FASCISTA.

FOR EXPLANATION OF PLATE SEE PAGE 592.



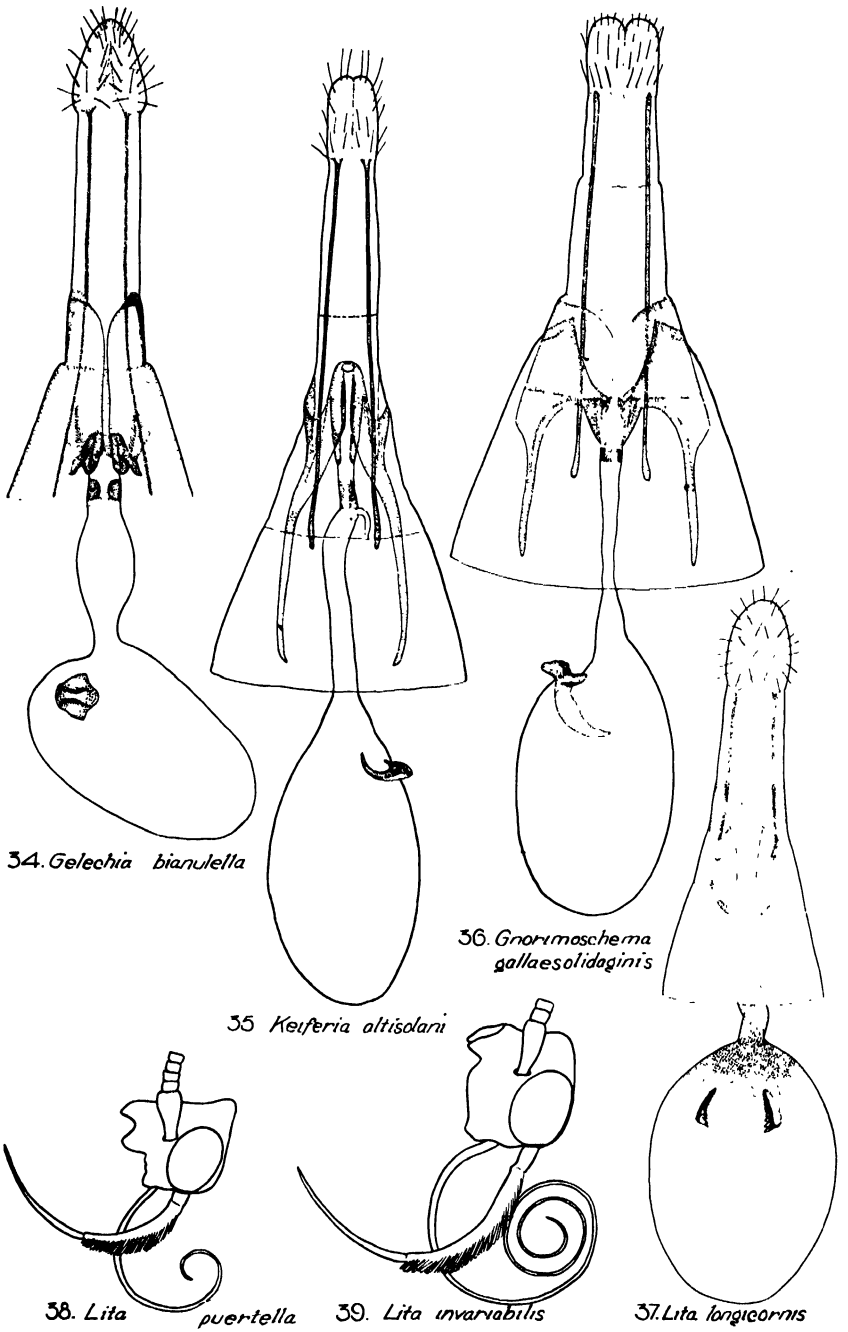
MALE GENITALIA OF NOTHRIS, STEGASTA, EVIPPE, AND ANACAMPSIS.

FOR EXPLANATION OF PLATE SEE PAGE 592.



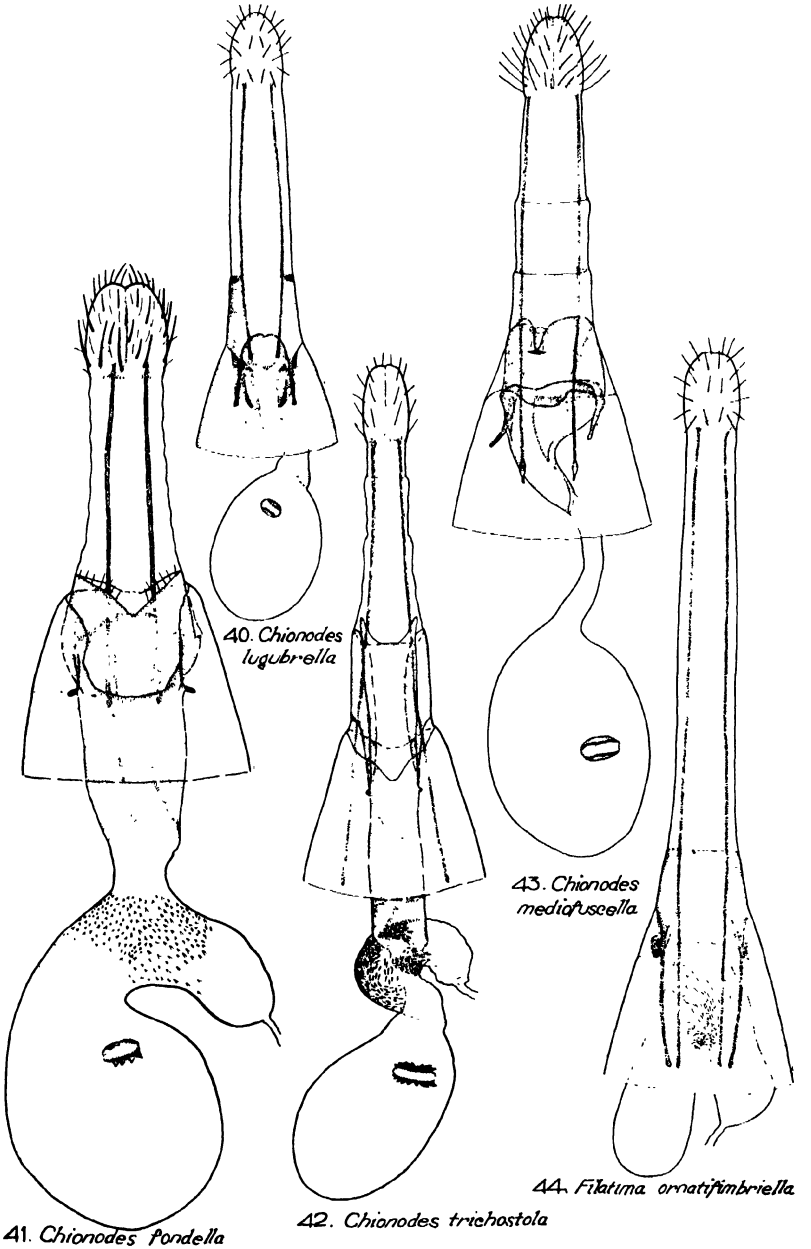
MALE GENITALIA OF RECURVARIA, STROBISIA, AND DICHOMERIS.

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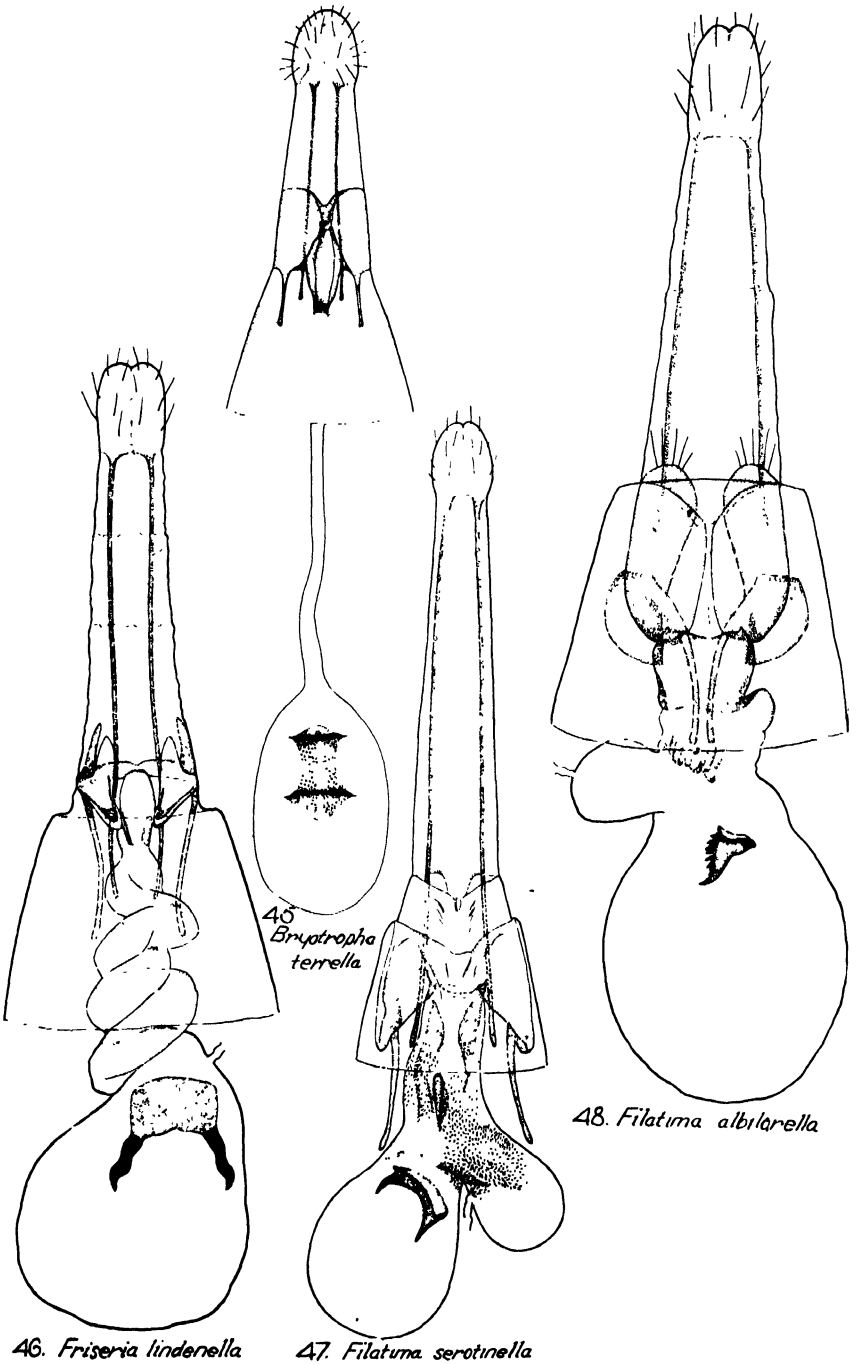
FEMALE GENITALIA OF GELECHIA, KEIFERIA, GNORIMOSCHEMA, AND LITA AND HEAD PROFILES OF LITA.

FOR EXPLANATION OF PLATE SEE PAGE 592.



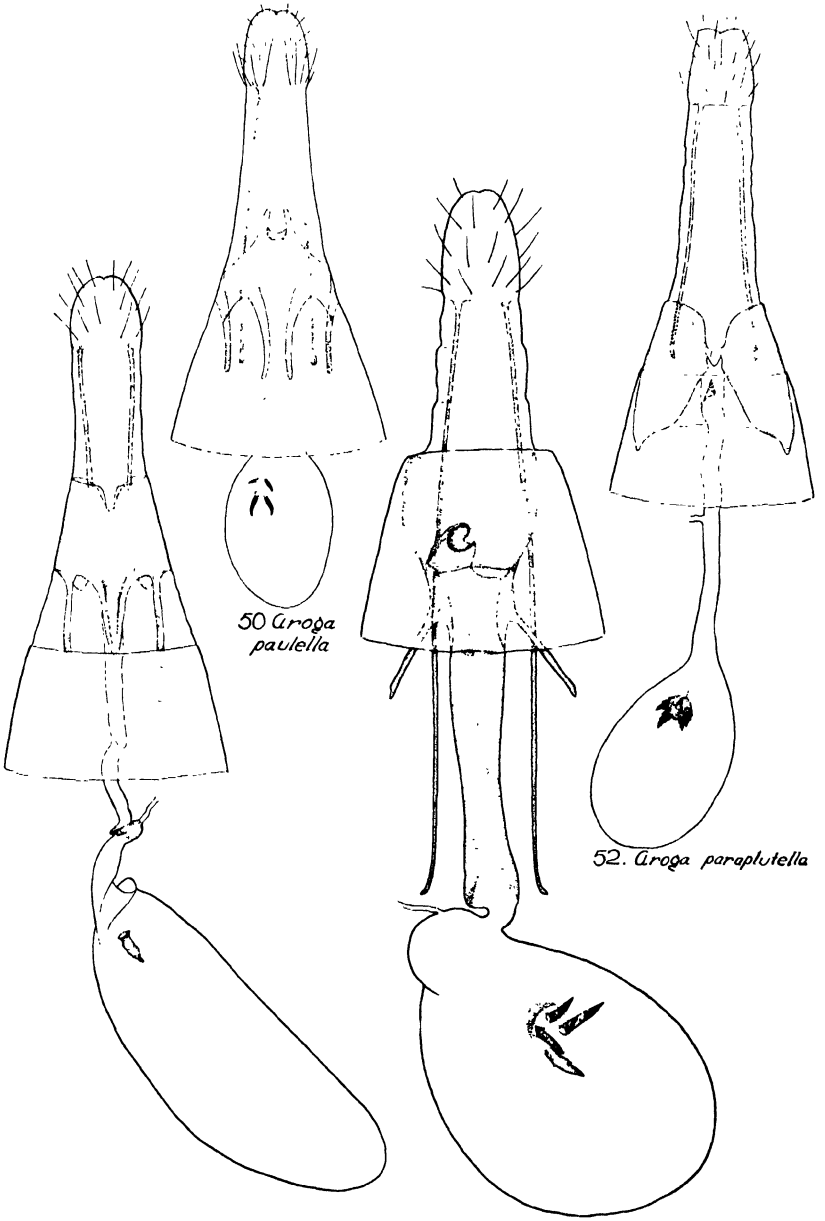
FEMALE GENITALIA OF CHIONODES AND FILATIMA.

FOR EXPLANATION OF PLATE SEE PAGE 592



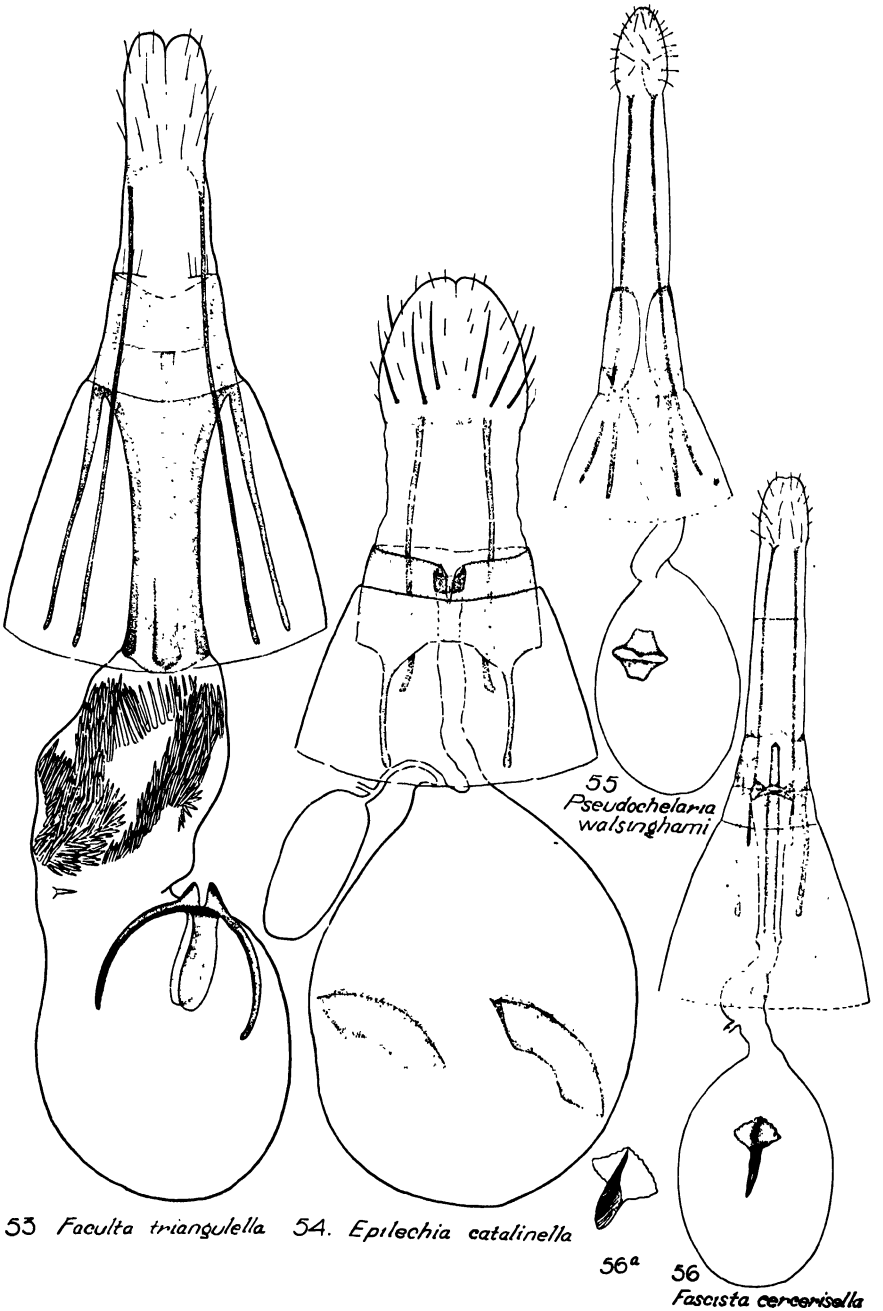
FEMALE GENITALIA OF BRYOTROPHA, FRISERIA, AND FILATIMA.

FOR EXPLANATION OF PLATE SEE PAGE 593.



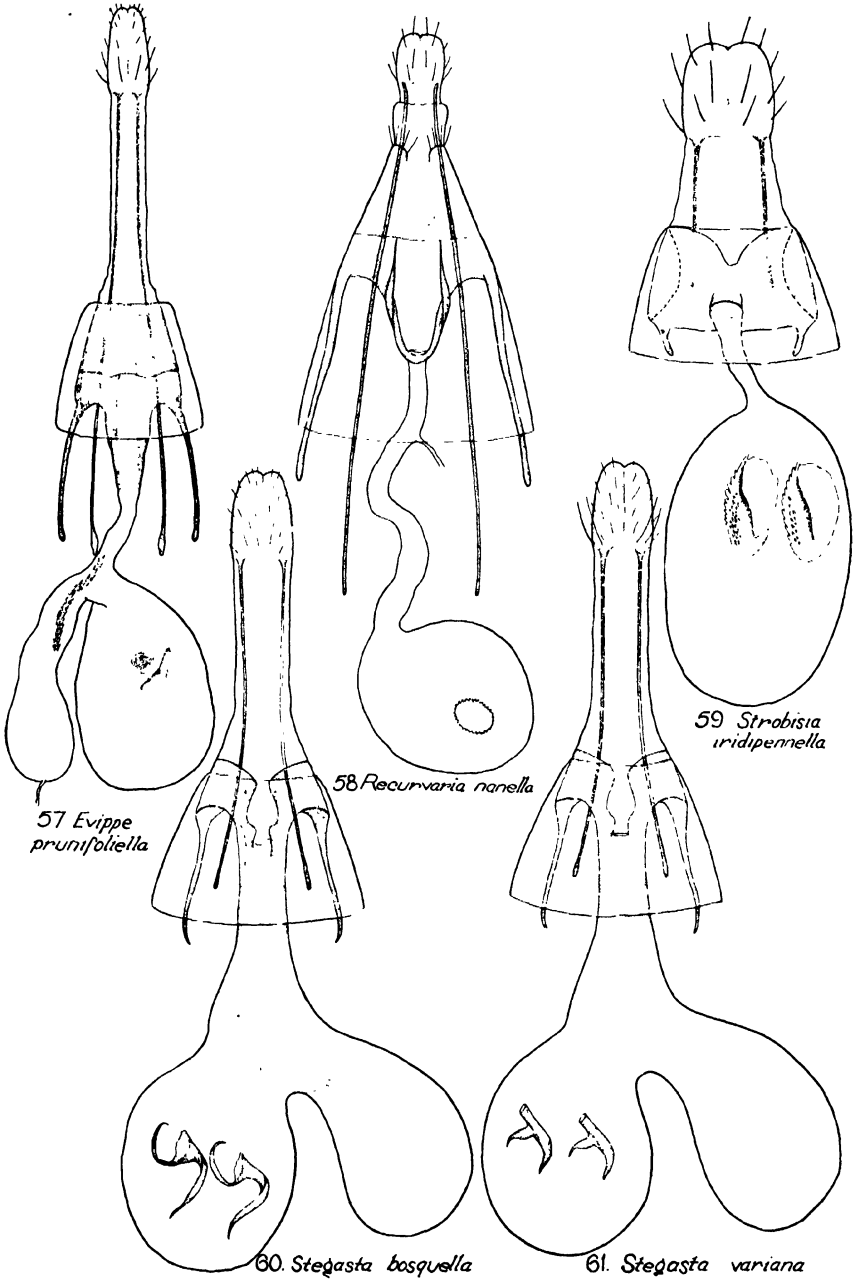
FEMALE GENITALIA OF FRUMENTA AND AROGA.

FOR EXPLANATION OF PLATE SEE PAGE 593.



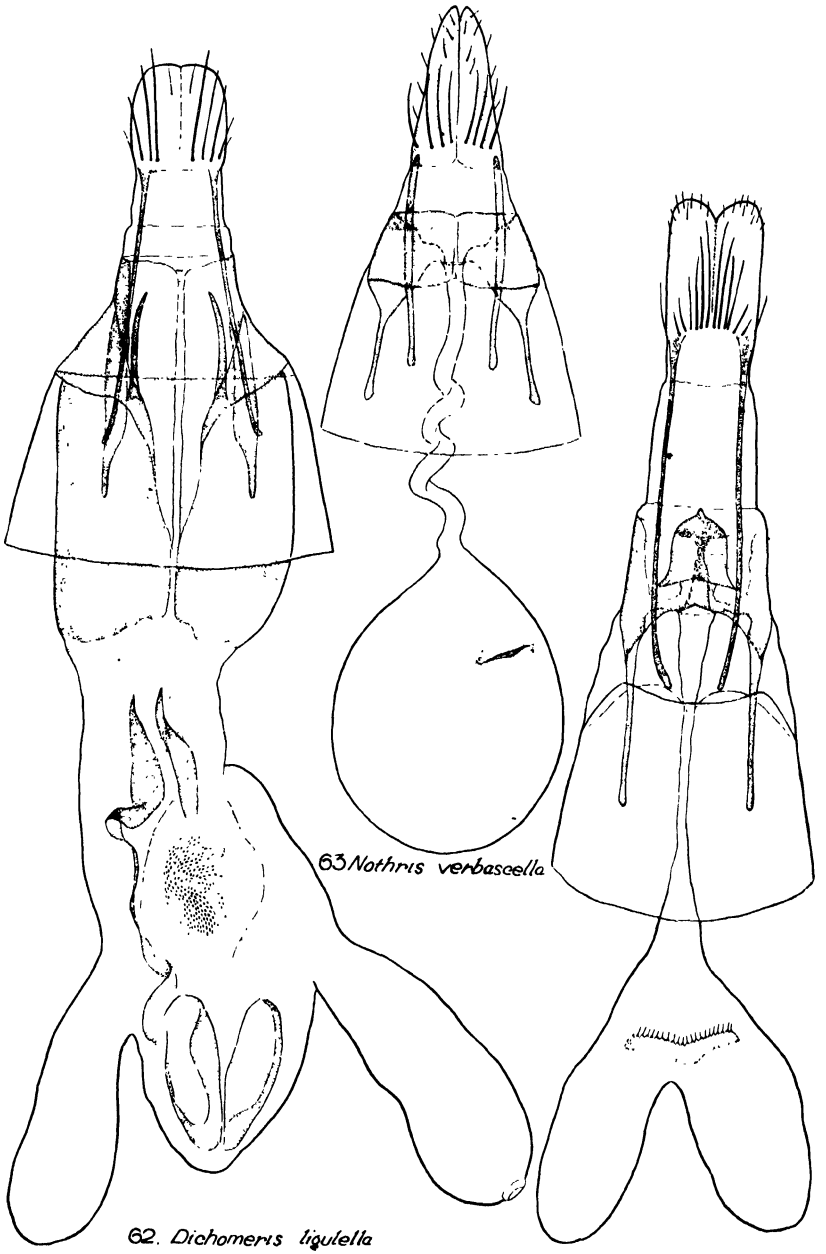
FEMALE GENITALIA OF FACULTA, EPILECHIA, PSEUDOCHELARIA, AND FASCISTA.

FOR EXPLANATION OF PLATE SEE PAGE 593.



FEMALE GENITALIA OF EVIPPE, RECURVARIA, STROBISIA, AND STEGASTA.

FOR EXPLANATION OF PLATE SEE PAGE 593.



FEMALE GENITALIA OF DICHOMERIS, NOTHRIS, AND ANACAMPSIS.

FOR EXPLANATION OF PLATE SEE PAGE 593.

PROCEEDINGS OF THE UNITED STATES NATIONAL MUSEUM

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NEOTROPICAL FLIES OF THE FAMILY STRATIOMYIDAE IN THE UNITED STATES NATIONAL MUSEUM

By MAURICE T. JAMES

A SMALL collection of Neotropical Stratiomyidae submitted to me for determination through C. F. W. Muesebeck, of the U. S. Bureau of Entomology and Plant Quarantine, contained several new species and additional material of exceptional interest. The present paper is based on this collection. All holotypes and allotypes are in the United States National Museum.

Subfamily BERIDINAE

Genus HOPLACANTHA Rondani

HOPLACANTHA MEXICANA (Bellardi)

One male, 5 females, Higuito, San Mateo, Costa Rica (Pablo Schild).

HOPLACANTHA PERUANA Enderlein

One female, Perene, Peru, April 18, 1937 (H. Hanson). Bishopp No. 27099. This specimen has the abdomen yellow in the center dorsally on segments 2 to 4; the face and lower part of the front are densely whitish pollinose and have the long, dense pile; the scutellum is 8-spined. Since these characters may well be variable, I believe I can safely refer the specimen to this species.

139916—39

Genus HETERACANTHIA Macquart

HETERACANTHIA RUFICORNIS (Macquart)

Three females, Higuito, San Mateo, Costa Rica (Pablo Schild).

Genus MACROMERACIS Enderlein

MACROMERACIS LONGICORNIS (Philippi)

FIGURE 71, *c*

One female, Ancud, Isla Chiloe, Chile, December 1926 (R. and E. Shannon). This specimen seems to belong to Philippi's *Beris longicornis*, and is clearly a *Macromeracis*, though differing somewhat in venation from Enderlein's diagnosis of the genus. It is here described in detail because of the brevity of Philippi's description.

Female.—Head black, subshining, with inconspicuous yellow hair; the occipital orbits (which are developed only on the upper part and are there very narrow), lower third of the front, and face whitish pollinose. Antennae black (segments beyond the second missing). Palpi and proboscis bright yellow. Thorax yellow; the dorsum, excluding the humeri, however, is brownish and becomes black laterally in front of the suture and posteriorly before the scutellum. Metapleura blackish. Scutellum blackish in the center, that color gradually merging into the broad yellow margin. Scutellum with four spines, the lateral pair directed outward, the median pair one and one-half times as long as the scutellum and three times as long as the lateral pair. Legs entirely yellow, the tarsi at most somewhat brownish at the apex. Discal cell large, two and one-half times as long as wide; the cross-vein r–m joins it at its basal fifth, and its apex reaches almost halfway between r–m and the origin of R_4. Four posterior cells; the fourth borders the discal cell for a greater distance than does the third. Abdomen three times as long as wide and three times as long as the thorax (excluding scutellum) and yellow, the first four segments dorsally with posterior subquadrate black spots, which are bluish in certain lights; those of the first segment are confluent with those of the second; a broad transverse band of similar color occupies the fifth and a broad, semicircular area on the basal and medial part of the sixth; this is confluent with the posterior spots of the fourth segment. Pile yellow, inconspicuous. Length, 7 mm.

The form of the discal cell readily distinguishes this species from *M. elongata* Aubertin and *M. thoracica* (Philippi).

Genus BERIDOPS Enderlein

BERIDOPS MACULIPENNIS (Blanchard)

Male, Bariloche, Rio Negro, Argentina, November 1926 (R. and E. Shannon).

Subfamily CLITELLARIINAE

Genus DIAPHOROSTYLUS Kertész

DIAPHOROSTYLUS INTERRUPTUS, new species

Differs from the three described species of this genus in that the legs, with the exception of the three apical segments of the anterior tarsi, are entirely yellow or white, without a trace of black or brown, and that the brown of the wings is more dilute, by no means blackish brown. As in *flavipes* Kertész, the hyaline band of the wing is interrupted near the discal cell.

Male.—Head black, white-haired, the front with some brownish hair intermixed; antennae yellow, its style, however, white; the style about two-thirds as long as the annulated portion; the subterminal bristle smaller than the terminal one. Facial projection acute. Thorax black; the pleura white-haired, the dorsum and scutellum with appressed golden hair; broad apex of scutellum and spines yellow. Abdomen bare, with only microscopic pubescence on the disk, but with longer blackish and white hairs intermixed on the sides. Legs, including coxae and trochanters, yellow; the apical three segments of the anterior tarsi brownish; the tibiae constricted basally; the constricted portions of the middle and hind tibiae whitish. Wings light brown; a hyaline band crosses the wing beyond the stigma, but this is broadly interrupted beyond the apex of the discal cell, so that the second posterior cell has only a small hyaline spot in it and the third is broadly infumated basally. Halteres yellow. Length, 4–5 mm.

Holotype.—Male, Alhajuelo, Panama, April 15, 1911 (August Busck), U. S. N. M. No. 52766.

Paratype.—Male, Cangrejal de Aserri, Costa Rica, 600 m. April 1906 (P. Biolley). Colorado State College collection.

Genus DITYLOMETOPA Kertész

DITYLOMETOPA ELEGANS Kertész

Female, Boa Vista, Tapajos, Para, "BV. 23. II" (C. H. T. Townsend).

Subfamily STRATIOMYINAE

Genus NOTHOMYIA Loew

This genus has been placed in the Geosarginae by most workers, but its close relationship to *Myxosargus* indicates that it belongs in the Stratiomyinae.

NOTHOMYIA VIRIDIS Hine

Male, Faxon mills, Trujillo Alto, San Juan, Puerto Rico, March 6, 1934 (Anderson). No. 5283. Compared with paratype specimens. This species was described from a large series from Cedar Point, Sandusky, Ohio, and has not since been recorded in literature.

NOTHOMYIA PARVICORNIS, new species

FIGURE 71, *a*

Readily distinguished from described species by the small size and bright yellow color of the annulated portion of the flagellum of the antenna.

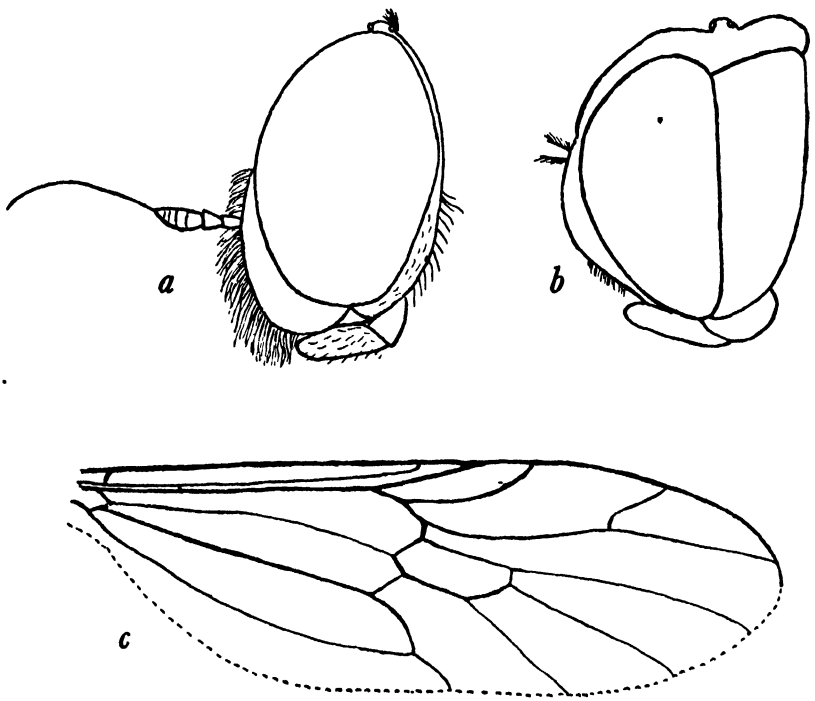


FIGURE 71.—*a, Nothomyia parvicornis,* new species, lateral view of head; *b, Cyphomyia planifrons,* new species, lateral view of head; *c, Macromeracis longicornis* (Philippi), wing.

Male.—Head greenish black. Face but little projecting forward, rather strongly produced downward, however, and rounded below; the face, front, and occiput clothed with dense pile, which, however, does not conceal the ground color; this pile is for the most part gray but is yellowish on the lower part of the face; in length it approximately equals the first antennal segment, but is somewhat longer on the lower part of the face and on the occiput below the neck. A tuft

of black pile on the ocellar triangle. Antennae small, in length, excluding the arista, less than half the longitudinal diameter of the eye, the arista almost as long as the longitudinal diameter of the eye; first and second segments subequal, shining black; the annulated part of the flagellum somewhat longer than the first or second segment, yellow; arista black. Dorsum of thorax densely punctured, emerald green, moderately shining, with yellowish-gray tomentum and scattered, erect, blackish pile; scutellum and spines concolorous, without the erect pile; spines divergent, almost as long as the scutellum. Pleura greenish black, well clothed with semiappressed grayish pile. Legs black, the posterior basitarsi white. Wings grayish hyaline; the stigma blackish; the area below it, including the discal cell, the apices of the basal cells, and the base of the first posterior, diffused yellowish brown. Discal cell hexagonal, but almost diamond-shaped. Vein M_3 weak, not much more than a fold. Vein R_4 absent. Halteres green. Abdomen black with a slight greenish cast, elongated oval, about twice as long as wide, grayish-white pilose. Length, 6 mm.

Holotype.—Male, San Carlos, Costa Rica (Schild and Burgdorf). U. S. N. M. No. 52764.

Genus DICYPHOMA James

DICYPHOMA SCHAEFFERI (Coquillett)

Female, Caño Saddle, Gatun Lake, Panama, April 27, 1923 (R. C. Shannon).

Genus CYPHOMYIA Wiedemann

CYPHOMYIA ALBITARSIS (Fabricius)

Six females, 1 male, Higuito, San Mateo, Costa Rica (Pablo Schild); 1 female, Porto Bello, Panama, March 2, 1911 (August Busck); 1 female, San Rafael, Veracruz, Mexico, April 18 (Townsend); 1 female, 1 male, Caño Saddle, Gatun Lake, Panama, April 27, 1924 (R. C. Shannon), and May 6, 1923 (M. F. Close); 2 males, Tabogal, Panama, February 2 and 23, 1912 (August Busck); 1 male, Valera, Venezuela.

CYPHOMYIA WIEDEMANNI Gerstaecker

Four males, Trinidad Rio, Panama, February 17, 1912 (August Busck); 1 male, Taboga Island, Panama, June 9, 1911 (August Busck); 1 male, 1 female, Caño Saddle, Gatun Lake, Panama, May 13 and 3, 1923 (R. C. Shannon); 1 male, 2 females, Higuito, San Mateo, Costa Rica (Pablo Schild); 1 female, Valera, Venezuela;

3 females, San Bernardino, Paraguay (K. Fiebrig); 1 female, Cavinas Beni, Bolivia, February (W. M. Mann), Mulford Biological Exploration of the Amazon Basin, 1921–22.

CYPHOMYIA NUBILIPENNIS, new species

A black species with predominantly yellow legs, white abdominal hair spots, and subhyaline wings, which are traversed by a brown cloud.

Female.—Head black; the lower part of the front and the upper part of the face, however, whitish to yellow, this color gradually darkening to black on the face. Front flat, slightly lower than the level of the eyes; almost parallel-sided, only slightly widened toward the vertex; there is no median furrow, but, on the other hand, the occular orbits on the upper half are very slightly depressed and punctured. Vertex behind the ocellar triangle elevated to the level of the triangle and separated from the occipital orbits by definite grooves. Occipital orbits of almost equal width throughout, though slightly broader above; they are narrow, averaging about a third the width of the front; the orbits angularly margined behind. Face divergent below, its width on the oral margin one and one-half times that at the base of the antennae. Pile yellowish white, on the front limited to the punctured areas, semiappressed; on the face longer, rather dense, and more erect. Proboscis brownish yellow; palpi black. Eyes bare. Antennae black, the first three segments yellowish basally; the first segment twice as long as the second, the second, ninth, and tenth of approximately equal length, the tenth acute at the apex; the flagellum (third to tenth segments) three times the length of the first. Thorax and scutellum black, slightly shining, with dense yellowish-white tomentum; the scutellum separated from the dorsum by a groove, raised above the dorsum and directed slightly upward; the spines thick, blunt, three-fourths as long as the scutellum, slightly divergent, directed upward in respect to the dorsum but not in respect to the scutellum. Legs yellow; the coxae, a subapical annulus on each femur (at least, below), the apical half of the hind tibiae, a narrow longitudinal stripe on the upper surface of the fore and middle tibiae, and the last three tarsal segments brownish. Wings yellowish hyaline; stigma yellow; a brown cloud crossing the wings anterior to the stigma and taking in the apices of the basal cells, most of the discal and fifth posterior cells, and the base of the fourth posterior cell. Halteres yellow. Abdomen black, with conspicuous side spots of yellowish-white tomentum on segments 2 to 5 inclusive. Length, 8 mm.

Holotype.—Female, Cayuga, Guatemala, June 15 (William Schaus). U.S.N.M. No. 52760.

CYPHOMYIA PILOSISSIMA Gerstaecker

Female, Mexico, Mexico (Juan Miller); male, Distrito Federal, Mexico (L. Conrad).

CYPHOMYIA FASCIPES Walker

Female, Caño Saddle, Gatun Lake, Panama, April 27, 1928 (R. C. Shannon); female, Amazon River near Obidos, Brazil, September 18, 1930 (Holt, Blake, and Agostini).

CYPHOMYIA PULCHELLA Gerstaecker

Female, Higuito, San Mateo, Costa Rica (Pablo Schild).

CYPHOMYIA PICTA Schiner

Female, Caño Saddle, Gatun Lake, Panama, May 17, 1923 (R. C. Shannon).

CYPHOMYIA SHANNONI, new species

A metallic-blue species, with a wholly yellow head and semihyaline wings with a large median brownish area. Close to *C. bequaerti* James.

Female.—Head yellow. Front approximately on a level with the eyes, slightly convex; its sides converging toward the base of the antennae, the relative widths at the anterior ocellus and at the insertion of the antennae being 16:11; the face likewise converging above, the relative widths at the base of the antennae and at the oral margin being 11:17. Occipital orbits moderately broad, broader above than below, their greatest width but slightly less than the width of the front at the narrowest point; the orbits moderately rounded behind. Vertex on a level with the front, sharply separated from the occipital orbits by deep furrows. Pile of front and vertex yellow, sparse, that of the rest of the head whitish, sparse, except on the sides of the face, where it is conspicuous and moderately long. Proboscis brown. Eyes bare; antennae black; the ratio of the first to the second segment 5:3; the third segment slightly shorter than the second, the others to the eighth gradually but slightly decreasing in length; the ninth and tenth segments are lost in the type. Thorax, including scutellum and spines, metallic bluish black, with abundant, mostly semi-appressed, whitish pile; tips of scutellar spines yellow. Scutellum on a level with the dorsum; the spines three-fourths the length of the scutellum, directed backward on a plane with the scutellum, and slightly outward, the spines slightly bowed. Legs black or brownish black, the knees and the first two segments of all tarsi yellow. Halteres yellow. Wings pale brownish subhyaline; the stigma dark brown; an indefinitely outlined lighter brown area taking in the

discal cell, the lower basal corner of the first submarginal cell, the apices of the two basal cells and of the anal cell, the basal parts of the first, second, and third posterior cells, and most of the fourth and fifth posterior cells; this is darker toward the stigma than near the posterior margin of the wing. Abdomen concolorous with the thorax; the pile mostly whitish and semiappressed; however, there are some scattered erect black hairs on the posterior tergites; no lateral spots of silvery appressed hair. Length, 8 mm.

Holotype.—Female, Caño Saddle, Gatun Lake, Panama, May 13, 1923 (R. C. Shannon). U.S.N.M. No. 52761.

A group of six Neotropical species of *Cyphomyia* has the body bright metallic blue or bluish, the wings deeply and uniformly infuscated with black, the antennae wholly black, and the legs (except in some specimens the base of the middle basitarsi) black, or metallic blue. The black posterior basitarsi offer a good character for separating some of these species from related ones. The following key will separate the females of the six species of this group:

1. Face black nigritarsis Enderlein
 Face yellow 2
2. Ocellar triangle situated on posterior margin of vertex; a black stripe connecting it with neck leucocephala Hoffmansegg
 Ocellar triangle remote from posterior margin of vertex; the space behind it wholly yellow 3
3. Vertex with conspicuous golden pile zernyi Lindner
 Vertex with inconspicuous whitish pile or bare 4
4. Vertex elevated in middle, depressed laterally, ocellar triangle at anterior end of prominence; scutellar spines white or yellow on at least apical half ecuadorensis Enderlein
 Vertex lies below level of ocellar prominence, at least immediately behind it; scutellar spines at most tipped with yellow 5
5. Ocellar triangle situated in a slight depression on front; front not elevated, but flattened and without a median trough. planifrons, new species
 Ocellar triangle elevated above vertex; front elevated laterally, with a median trough running from ocellar triangle to base of antennae altifrons, new species

CYPHOMYIA ECUADORENSIS Enderlein

Seven females, Bogota, Colombia (B. Guevara).

CYPHOMYIA PLANIFRONS, new species

FIGURE 71, *b*

Female.—Head yellow. Relative width of front at anterior ocellus, front above insertion of antennae, face immediately above oral margin, occipital orbit at upper corner of eye, and occipital orbit at center of eye, 30:23:28:20:17. Vertex separated from occipital

orbits by a moderately deep groove; the occipital orbits moderately rounded behind, front moderately convex, flattened above, and without a median groove; the posterior part of the front somewhat depressed, the ocellar prominence rising from this depression; the vertex rising from this depression, at its greatest elevation approximately level with the ocellar prominence. Pile of head white, inconspicuous except on the sides of the face. Eyes bare. Antennae black, the first two segments black-haired; the ninth segment twice as long as the tenth. Proboscis and palpi black. Thorax metallic violet-blue; scutellum and spines concolorous, the latter, however, tipped with yellow, scutellum on a level with the dorsum; the spines directed straight backward, slightly curved, about three-fourths the length of the scutellum. Pile of thoracic dorsum black, inconspicuous, that of pleura whitish. Wings deep black. Halteres black. Legs metallic blue, the tarsi black; the middle basitarsi at most slightly brownish basally; tarsi with dense, short, golden pile which may make them appear yellow to the naked eye. Abdomen concolorous with the thorax; pile inconspicuous, black dorsally, whitish on venter. Length, 12 mm.

Holotype.—Female, Bogota, Colombia (B. Gueyara). U. S. N. M. No. 52762.

Paratype.—Female, same data.

CYPHOMYIA ALTIFRONS, new species

Male.—Head yellow, the occiput black only in the middle. Eyes separated at their nearest point by a distance equal approximately to the width of the second antennal segment; the vertical triangle, including the upper part of the front, enormous, inflated, greatly elevated above the eyes and the occipital orbits; the latter well developed. The relative width of the vertex at its widest point, of the front at its narrowest point, of the face above the oral margin, and of the occipital orbits (average), 26:4:22:10. Pile of vertex and occiput sparse, whitish; that of face light yellow, conspicuous. Eyes bare. Antennae black, the first and second segments black-pilose; segments 2, 8, 9, and 10 subequal in length, the first twice as long as the second. Thorax metallic violet-blue; pile black dorsally, whitish on pleura, in one specimen with slight evidence of a median dorsal golden band; scutellum and spines concolorous with the thorax, the spines yellowish at their tips; pile black. Spines almost as long as the scutellum. Legs metallic blue, the tarsi black; the middle and sometimes the other basitarsi somewhat yellowish basally; the basitarsi with dense yellow pile, which may make them appear yellow to the naked eye. Wings deep black. Abdomen concolorous with the thorax, black-haired. Length, 11–12 mm.

Female.—Sides of face and front parallel, only very slightly narrowed near the insertion of the antennae. Front and vertex elevated, the elevations taking the form of two folds running from the occiput to a point above the insertion of the antennae; the space between the folds is furrowed troughlike, but not sulcate; the ocellar triangle arises from this furrow. Vertex and occipital orbits divided by a distinct but only moderately deep groove, occipital orbits broader above than below; on an average, about three-fifths the width of the front. Tenth antennal segment twice as long as the ninth. Thoracic dorsum with a transverse patch of white pile, extending a short distance along the suture, and anterior to it; this is continuous with an area of similar hair on each pleuron; postalar calluses white-haired. Scutellar spines wholly blue, about half as long as the scutellum. Tarsi wholly black. Otherwise as in the male.

Holotype.—Male, Bogota, Colombia (B. Guevara). U.S.N.M. No. 52763.

Allotype.—Female, same data.

Paratopotypes.—3 males, 3 females, same data.

Remarks.—In spite of the differences in detail, I believe the males and females described above to be conspecific.

This species is close to that described by Gerstaecker as *C. cyanea* Fabricius but may readily be distinguished by the fact that in *altifrons* the vertex and front in the female are not so high, the former not being bubblelike ("blasenförmig"), and the basitarsi are black; and the occiput in the male is yellow, with the orbits well developed. The development of the male occipital orbits is a condition similar to that found in *C. androgyna* Williston.

CYPHOMYIA CYANEA (Fabricius)

Three females, upper Putamayo River, Colombia (B. Guevara); 1 male, Bogota, Colombia (B. Guevara).

These female specimens agree with Lindner's redescription and figure of *C. cyanea*,[1] but not with Gerstaecker's figure, which Lindner considers an exaggeration. The eyes are hairy, as Lindner shows them. The male agrees with Fabricius's brief description, but it does not have the prominent vertex mentioned by Gerstaecker. The discovery of *altifrons* leads me to believe that Gerstaecker may have had a similar species, which he misidentified for *cyanea*.

CYPHOMYIA VARIPES Gerstaecker

Two females, Higuito, San Mateo, Costa Rica (Pablo Schild).

[1] Ann. Naturh. Mus. Wien, vol. 43, pp. 262–264, 1929.

CYPHOMYIA CHRYSODOTA Perty

Two females, San Jose, Costa Rica (Schild and Burgdorf); 1 female, Tucurrique, Costa Rica (Schild and Burgdorf). This species seems to be distinct from the closely related *auriflamma;* specimens of *chrysodota* are smaller and slenderer, and the face, especially in the male, is much more densely clothed with wholly snow-white pile.

Subfamily GEOSARGINAE

Genus PTECTICUS Loew

PTECTICUS TESTACEUS (Fabricius)

One male, Cabima, Panama, May 21, 1911 (August Busck); 1 male, 1 female, Taboga Island, Panama, June 9 and 10, 1911 (Busck); 1 male, 1 female, Higuito, San Mateo, Costa Rica (Pablo Schild).

Genus MEROSARGUS Loew

MEROSARGUS CINGULATUS Schiner

Six females, Barro Colorado Island, Canal Zone, on fruits of *Ficus* sp., November 1934, No. 3415 (James Zetek); 1 female, Higuito, San Mateo, Costa Rica (Pablo Schild); 3 females, Caño Saddle, Gatun Lake, Panama, August 6 and 17, 1923 (R. C. Shannon).

MEROSARGUS STAMINEUS (Fabricius)

One female, Cabima, Panama, May 23, 1911 (August Busck).

MEROSARGUS GOWDEYI Curran

Two males, Porto Bello, Panama, March 15, 1911 (August Busck); 1 female, Caño Saddle, Gatun Lake, Panama, May 17, 1923 (R. C. Shannon).

MEROSARGUS SUBINTERRUPTUS (Bellardi)

One male, Barro Colorado Island, Canal Zone, May 17, 1923 (R. C. Shannon).

Genus CHRYSOCHROMA Williston

CHRYSOCHROMA FLAVOPILOSUM (Bigot)

Two males, Higuito, San Mateo, Costa Rica (Pablo Schild).

CHRYSOCHROMA AENEIVENTRIS (Giglios-Tos)

One female, Cayuga, Guatemala, June 15 (William Schaus); 1 female, Tuxtepec, Oaxaca, Mexico, No. 59 (Joaquin Camelo). I be-

lieve these specimens to belong to Giglio-Tos' species, in spite of several variations from the original description, namely that the middle and posterior coxae are yellow, the abdomen is green on the venter as well as on the dorsum, and the face immediately below the antennae is yellow (only the depressed oral margin being black). In view of the variation that may occur in species of Geosarginae, these characters may easily be variable to this extent. The black areas on the apices of the middle femora are sharply defined, and less so on the fore and hind femora; on the middle femora the black area is much more extended ventrally than dorsally.

Subfamily PACHYGASTRINAE

Genus ARTEMITA Walker

ARTEMITA HIEROGLYPHICA (Wiedemann)

One female, Amazon River, Arary to Manaos, Brazil, September 20–21, 1930 (Holt, Blake, and Agostini).

Genus EUPACHYGASTER Kertész

EUPACHYGASTER VILLOSA, new species

Readily distinguishable from the two American species that have been referred to this genus by the narrow front and the dense silvery tomentum of the thoracic dorsum in the female and the contiguous eyes and slender abdomen in the male.

Female.—Head black, shining; the lower half of the front (except a narrow median longitudinal line) and the sides of the face silvery pollinose. Front narrow, at its narrowest part (near the middle) two-thirds as wide as the base of the ocellar triangle, and one-third as wide as at the insertion of the antennae; the face gradually becomes broader. Head three-fourths as long as high, the antennae inserted somewhat below the middle. Antennae and proboscis yellow. Arista bare. Occipital orbits undeveloped, except below. Thorax black, the dorsum and scutellum densely and uniformly clothed with silvery tomentum; the scutellum with a definite rim, which is beset with numerous minute teeth. Pleura shining, bare. Legs, including coxae, wholly yellow. Wings hyaline, with a slightly yellow cast; vein R_{2+3} originating slightly beyond cross-vein r–m, which is short but distinct; R_5 slightly more than twice as long as R_4. Halteres yellow. Abdomen about as wide as long, black, with scattering whitish hairs. Length, 3 mm.

Male.—Eyes contiguous, the facets above larger than those below but not divided from them by a definite line. Head almost as long as high. Thorax and scutellum with scattering yellowish-white hair,

the abdomen similarly haired. Body much slenderer than in the female, the abdomen being only three-fourths as broad as long. Vein R_{2+3} originating before cross-vein r–m. Length, 2.5 mm.

Holotype.—Female, Higuito, San Mateo, Costa Rica (Pablo Schild). U.S.N.M. No. 52765.

Allotype.—Male, same data.

Paratopotypes.—Three females and 3 males, same data.

Remarks.—The generic position of this species is given only provisionally. In Kertész's key [2] it traces to *Abiomyia* (males) or to couplet 152 (females); in Curran's key [3] it traces readily to *Eupachygaster*. According to the classification of Kertész, our species of *Eupachygaster* are not congeneric with *Pachygaster tarsalis* Zetterstedt, the type of the genus; *E. punctifer* Malloch and *E. henshawi* Malloch should form a separate genus, and *E. villosa* still another one. To take such a step would, however, be unwise, unless one had abundant material and could make a thorough study of this difficult group. It is possible that too many genera of Pachygastrinae have already been proposed.

[2] Ann. Mus. Nat. Hungarici, vol. 14, pp. 127–140, 1916.

[3] The families and genera of North American Diptera, 512 pp., 1934. New York.

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